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## A SYSTEMATIC REVIEW OF THE BOOMING NIGHTHAWKS OF WESTERN NORTH AMERICA

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The foundation work bearing on the systematics of the nighthawks of the genus *Chordeiles* is that of Oberholser (1914). At the time of that author's revision, specimens of the Booming Nighthawk (*Chordeiles minor*) were not sufficiently numerous to permit a thorough study of geographic variation, especially as regards the intergradation of the western races. From Idaho, Utah, and Nevada only a few specimens from scattered localities were available. As material from western North America has gradually accumulated, considerable confusion has arisen regarding the geographic distribution, characters, and variation of some of the races. This has resulted in the not infrequent allocation of breeding birds from a single locality to two or more different subspecies.

Recently, Hawkins (1948) described birds from the Snake River region of southern Idaho and the Warner Valley, southeastern Oregon, as a new race, *twomeyi*, and suggested that birds from northwestern Utah and southeastern Washington might also be referable to that form.

The present work began as a study of the nighthawks of northern Utah. In the summer of 1950, collections were made in northern Utah and southern Idaho. Study of the relationships of these birds necessarily involved examination of specimens from all the western states, western Canada, and northern México. As a result, additional information concerning all the western races has come to light which permits a more precise analysis of variational trends. A survey of molts and plumages revealed characters distinguishing first-year individuals from adults.

I am indebted to the following persons for the loan and use of specimens: Miguel Alvarez del Toro, Museo Zoológico, Chiapas, México; Alfred M. Bailey, Denver Museum of Natural History; Herbert Friedmann, United States National Museum; C. Lynn Hayward, Brigham Young University; Frank A. Pitelka, Museum of Vertebrate Zoology; W. E. Clyde Todd, Carnegie Museum; and Robert T. Orr, California Academy of Sciences. Acknowledgment is made to Harold G. Higgins for permission to incorporate some of the data from his unpublished study "The Nighthawks of Utah" (1948) in the present report, and to Alden H. Miller for critical reading of the manuscript. V. G. Duran took the photographs of specimens.

Field work and preliminary study were accomplished in 1950 with the support of a Graduate Research Fellowship from the University of Utah Research Fund, and the work was completed at the Museum of Vertebrate Zoology in 1953, during which time the author held a Willard D. Thompson Memorial Fellowship and a National Science Foundation Fellowship.

### TYPES OF VARIATION

The complex variation of this species has been described in detail by Oberholser (1914), but it is necessary to review and clarify certain points, especially as regards molts and plumages.

*Sexual differentiation.*—Characters distinguishing the adult female from the adult male include: (1) smaller size; (2) smaller size and mottled appearance of the white wing patch; (3) almost invariable absence of a conspicuous white subterminal tail bar; (4) pigmentation of the throat crescent; (5) browner, buffier, or more ochraceous under parts, especially posteriorly; (6) wider ventral dark bars; and (7) coarser dorsal mottlings in all western races, although in *howelli* they frequently are more vermiculiform.

As regards characters 5 to 7, degree of sexual differentiation varies from one racial population to another. Thus in *henryi*, *minor*, and *hesperis*, the sexes resemble one another more closely than in *sennetti* and *howelli*. In *henryi* and *minor* specimens of the

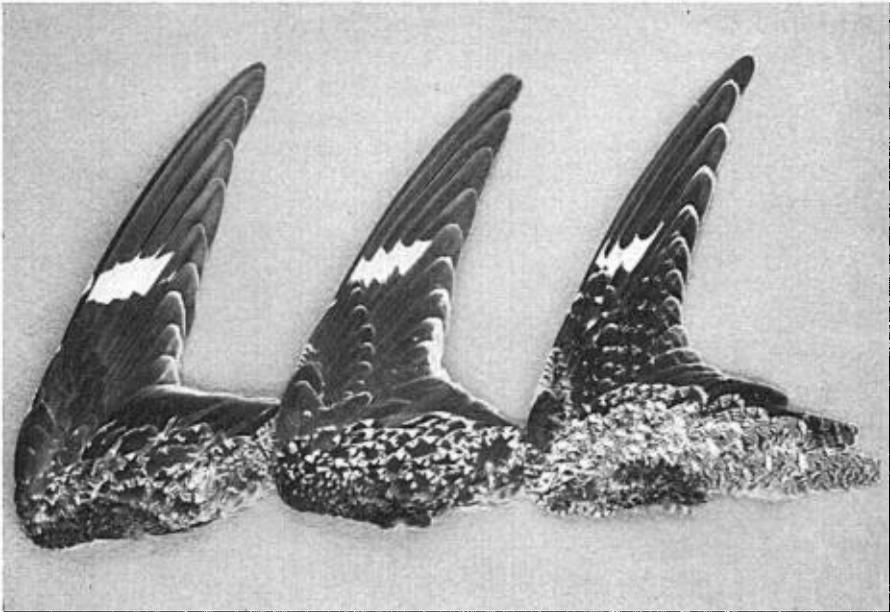


Fig. 1. Age differences in the wings of males of *Chordeiles minor*. Left to right: adult; first-year, showing retained juvenal primaries, secondaries, alula, marginal coverts of the manus, greater primary coverts, and distal greater secondary coverts; juvenile. Specimens are *C. m. hesperis*.

two sexes are, in fact, often difficult to distinguish on the basis of these characters alone, without reference to the presence or absence of a white subterminal tail bar and a well defined white throat patch. *Howelli* shows the extreme in sexual differentiation.

*Molts and plumages and age differentiation.*—It is not adequately known to what extent the downy young show individual and geographic variation, but racial color differences become apparent as the feathers of the juvenal plumage begin to replace the natal down.

In the juvenal plumage both sexes are similar in appearance and are much lighter dorsally than the adults by reason of a paler ground color of their feathers, a greater abundance of fine vermiculations, and a terminal splotch of solid color on the body feathers and wing coverts, which ranges, in the different races, from white to dark tawny. The ventral dark bars are more numerous, narrower, paler, and more extensive anteriorly, and the dark areas of the breast are paler. The light throat patch is poorly defined in both sexes, being barred and mottled, but it is usually slightly better developed in the

male. The conspicuous white subterminal tail bar, which is characteristic of the adult male, is lacking in the juvenile, and the wing patch is smaller and less uniform in width than that of the adult (fig. 1). The juvenal male of a given race has the wing patch about the size of that of the adult female of that race, whereas that of the juvenal female is still smaller. The juvenal remiges, greater primary coverts, and, to a lesser degree, the rectrices are broadly and abruptly edged terminally with white or buff, and the proximal 4 or 5 primaries are marked with mottled light bands (fig. 1). Juvenal contour feathers differ in structure from those of the adult in being laxer and in having a less substantial rachis. Juvenal primaries are narrower than those of the adult.

In Utah and southern Idaho the juveniles generally first appear in the feeding flocks in the early part of August (Higgins, 1948:9) and usually they have completed growth of their juvenal plumage by the end of the month.

The juvenal plumage is retained only a short time, being succeeded by what Oberholser (1914:27-28) has termed the first-autumn plumage through a molt of the contour feathers. This molt occurs in September, when migration is getting under way (see page 67). The majority of the September juveniles examined are in various stages of transition between juvenal and first-autumn plumage. On the dorsum, the highly vermiculated juvenal feathers are replaced by feathers similar to those of the adult plumage, from which they differ in being duller and slightly laxer. Replacement at this molt involves most, if not all, of the contour feathers, including the marginal coverts of the wing, but the greater, middle, and lesser upper wing coverts are retained at least through September and until the birds have departed from North America. In the accounts of the races which follow, birds in juvenal or first-autumn plumage are referred to as "immatures."

When the immatures are in the later stages of attaining the first-autumn plumage, they are similar in appearance to the adult females but they have more numerous pale, dorsal mottlings, the anterior under parts are more abundantly mottled with gray or dull buff, and the throat patch is less well defined. They also are smaller than the adults as regards length of wing and tail.

In the first-autumn plumage sexual differentiation is more evident than in the juvenal plumage in that the female has the throat patch noticeably more heavily mottled than in the male. The lightish-edged juvenal primaries, secondaries, and rectrices serve to distinguish these birds from adults.

With reference to the sequence of molts and plumages of adult birds, that is, those a year or more of age, my findings are at variance with those of Oberholser (1914:28) and Gross (1940:221-224). According to Oberholser "the adult birds after the breeding season molt usually the contour feathers, but not the wing quills and rectrices, this taking place between the middle of July and the middle of September, mostly between July 15 and August 15." This statement requires some revision, at least as it applies to the western races.

One hundred July birds from various parts of the western United States were examined for molt, the vast majority of which show no evidence of molt other than that attributable to replacement following adventitious loss of feathers. Several specimens taken in southern Idaho on July 31 show partial replacement of the flanks and/or small patches of ensheathed feathers on the breast. Of 51 August specimens examined, only 14 show replacement on a scale at all indicative of a definite molt. These birds have small patches of ensheathed feathers or single, scattered new feathers on the breast, belly, head, nape, and scapular region. Usually molt is first evident on the abdomen or upper breast, but some birds replace several of the scapulars before molt begins in any other areas. The intensity of molt is comparatively weak, with only a few feathers molt-

ing at a time. No August specimen examined shows more than partial replacement of the body feathers. Most of the molting individuals were collected after August 15; an exception is a male (*henryi*) from Chihuahua, México, collected on August 1, which had molted most of the feathers of the under parts, nape, and scapular region. September birds show little advancement over August specimens. The most advanced bird, a female (*hesperis*) taken in Custer County, Idaho, on September 7, had replaced the scapulars and most of the feathers of the nape, breast, and belly. Another female from the same locality, taken on September 1, had some new scapular and crown feathers, and two other September birds were not molting. A migrant female (*hesperis*) collected on October 2 in Sonora, México, is in worn plumage and shows no signs of molt.

It is clear, then, that in the western races there is no regular occurrence of an extensive postnuptial molt prior to migration. Many, perhaps the majority, of the birds apparently perform migration in worn breeding plumage. Those individuals beginning molt before migration may be birds which, for one reason or another, are not occupied with nesting activities during late July and August.

I have not examined birds taken on their wintering grounds and so have been unable to trace through the molt, or molts, which occur during the winter months. According to Oberholser (1914:28), both immatures and adults undergo a complete molt in January or February, after which they are similar in appearance, but Gross (1940:224) stated that he was unable to determine the time of this molt. The relatively unworn condition of most of the feathers of birds returning to their breeding grounds in May or June indicates that there is a molt shortly before spring migration, possibly later than January or February. April specimens occasionally show a few growing feathers on the nape or breast, but whether this represents the concluding stage of the molt at which the flight feathers are replaced, as seems likely, or a separate molt was not determined. In any event, by May the immatures of the preceding fall have replaced the contour feathers and rectrices of the first-autumn plumage with feathers which are indistinguishable from those of the adult. A fact which appears to have been overlooked by Oberholser and Gross is that many of the first-year birds retain the juvenal primaries, secondaries, alulae, and a number of the upper wing coverts. Although abrasion at the tips of the primaries, alulae, and greater primary coverts tends to obliterate the abrupt light terminal edging characteristic of juvenal feathers, this edging usually persists on the inner two or three primaries and on the secondaries. The worn and faded condition of these feathers, the presence of indistinct light bands on the proximal four or five primaries, the small size of the wing patch, and the shortness of the wing provide additional characters by which first-year birds may be recognized (fig. 1). As a rule all the greater primary coverts and at least several of the greater secondary coverts are retained, and occasionally some of the middle secondary coverts are not replaced. The wing of the first-year male in figure 1 shows the common condition of partial replacement of the juvenal greater secondary coverts. Apparently no further replacement takes place after the birds arrive on the nesting grounds.

In addition to those birds which retain all the juvenal remiges, other first-year individuals may be recognized by the possession of one or more juvenal secondaries and secondary coverts in an otherwise adult wing. Of 135 May and June specimens having adult primaries, 57 show one or more juvenal secondaries. Apparently some immature birds begin replacement of the secondaries at the molt preceding spring migration but fail to complete replacement of the wing. Juvenal secondaries are recognizable by their faded and worn appearance in contrast to the relatively fresh condition of the newly grown feathers. The number of juvenal secondaries retained varies from all (13) to one, the usual condition being the retention of the central 2 or 3, with replacement on either

side. The greater secondary coverts may or may not be replaced. Occasionally replacement of secondaries is asymmetrical in the two wings. Only one definite case of partial replacement of the primaries was noted. This bird, a male *chapmani* from Cameron, Georgia, May 27, had replaced the two innermost primaries of the right wing and the single innermost primary of the left. Four of the central secondaries in either wing are juvenal while the remaining secondaries are fresh and adult in appearance. The alulae and some of the greater secondary coverts are juvenal. The relative scarcity of birds of this type suggests that once replacement of the primaries is initiated it is usually carried to completion.

The distinction between juvenal and adult secondaries becomes less obvious as the season progresses and the effects of wear increase, so that separation of adult and first-year July and August birds on this basis becomes increasingly difficult.

As regards the group of birds returning to the breeding range with a full complement of new remiges, and which probably is composed of both fully adult and first-year individuals, further age segregation was not attempted. If a first-year bird retained certain of the juvenal wing coverts, its age could be determined, even though the primaries and secondaries had been replaced, provided that fully adult birds replace all of the coverts of their preceding breeding plumage. However, it seems that the molt which occurs prior to spring migration rarely involves replacement of all the wing coverts *even* in fully adult birds. With the exception of an occasional specimen having all fresh coverts, the spring birds with all new remiges have either some of the marginals, greater, middle, or lesser secondary coverts conspicuously worn and faded (and, hence, apparently older) as compared to the relatively unworn condition of the other coverts and other parts of the plumage. In some cases coverts of three apparent ages are present. In most specimens about half of the proximal marginals of the manus are fresh while the distal ones are faded and worn. The number of old coverts in the wing varies individually from two or three to a condition in which half of the coverts are of this type. When few in number, they are most frequently clustered at the bend of the wing. They tend to occur in rows but are frequently scattered, apparently at random, throughout the rows of otherwise fresh feathers. In many instances new and old feathers alternate irregularly or a single worn feather occurs in a row of fresh ones. The highest incidence of old feathers is among the median secondary coverts. No evidence was found to suggest that these old coverts are replaced after the birds return to their breeding grounds.

In some birds having mixed coverts, especially those having a large proportion of worn ones, the older feathers show a degree of wear comparable to that shown by the retained juvenal coverts of birds known to be first-year by reason of possession of juvenal primaries and secondaries. This similarity would suggest that they are, in fact, juvenal feathers retained when the juvenal primaries and secondaries were molted. However, in other birds the older coverts are much more worn and faded than those of known first-year birds, suggesting that they represent retained coverts of the preceding breeding plumage. As noted earlier, some birds have three classes of coverts: the majority relatively unworn, a small number moderately worn, and a very few extremely worn.

*Comparison of molts and plumages of C. minor and C. acutipennis.*—In working out the sequence of plumages in *C. minor*, I also surveyed the plumages of *C. acutipennis*, using 180 specimens in the Museum of Vertebrate Zoology. This material consists in large part of specimens of *C. a. texensis* collected in the breeding season in California and specimens of that race from México (mainly Guerrero) taken in winter and in April. The collection also includes a few specimens of *inferior* from Lower California and *micromeris* from El Salvador. In general my findings confirm those of Oberholser (1914:87-88).

Although *C. minor* and *C. acutipennis* seemingly are quite closely related, they show certain important differences in molts and plumages. A basic difference is that in *C. acutipennis* the juvenal tail feathers show sexual dimorphism as regards the presence or absence of a subterminal tail band, which is in contrast to the condition in *C. minor* where juveniles of both sexes have the tail similar in appearance to that of the adult female.

At least in *C. a. texensis* the juvenal birds molt the contour feathers (including the lesser wing coverts), beginning usually in September. The new contour feathers are adult in appearance, so there is no distinctive first-autumn plumage. The majority of the immatures retain their juvenal remiges and rectrices through the subsequent winter and summer. As in *C. minor* the juvenal primaries, greater primary coverts, and secondaries are broadly and abruptly edged with gray, buff, or tawny and are recognizable throughout the year. It seems certain that some immature birds carry out a partial replacement of the remiges at the postjuvenal molt, since a number of spring-taken specimens with adult primaries show two or three (rarely more) worn juvenal secondaries and greater secondary coverts.

The adults of *C. acutipennis* have a complete postnuptial molt which for birds breeding in the southwestern United States usually begins in July (earliest, June 27). This molt is initiated with the loss of the first (proximalmost) primary. At about the time the seventh primary is being replaced, molt of the tail and secondaries begins with the loss of the two central rectrices and the distalmost secondary. The rectrices are then replaced in sequence toward the outside. The secondaries may show some irregularities in sequence of replacement. At about this same time molt of the scapulars and upper tail coverts begins.

In March and April the adult birds returning to the southwestern states are in relatively fresh plumage. There appears to be no prenuptial molt. There is no regular occurrence of old, retained coverts in spring birds having totally adult remiges, but a small proportion (about 5 per cent) of these birds have a few scattered worn coverts intermixed with fresh ones. It seems probable that such individuals are first-year birds which have replaced all of the remiges.

It is not unlikely that certain of the variations and peculiarities of plumage in *C. minor* arise from imperfections in adjustment of the molt pattern as a consequence of the delay of the "complete" molt until the wintering grounds are reached. In the more southerly distributed species, *C. acutipennis*, for which the length of the breeding season is less severely restricted by seasonal climatic changes and of which only the more northern populations are migratory, it is noteworthy that the pattern and sequence of molt is "normal" in that the complete postnuptial molt occurs immediately following the breeding season.

*Individual variation.*—*Chordeiles minor* exhibits an unusually wide range of individual variation in color and pattern of the plumage. In many local populations variants resembling several of the races occur with regularity as breeding birds. Juveniles appear to be considerably more variable than adults, but this variability results in some part from the circumstance that many of these birds are undergoing transition from juvenal to first-autumn plumage.

Unlike many caprimulgids, such as *Nyctidromus albicollis* and *Phalaenoptilus nuttallii*, adults of *C. minor* do not show pronounced color phases. In the juveniles of the races *minor* and *hesperis*, however, there is some tendency toward dichromatism in that two types occur: one (the more common) has mostly whitish dorsal mottlings and the other shows mostly dark buff or tawny markings.

Occasionally a variant is collected which has characters not encompassed within the

usual variational range of any of the subspecies. For example, I have seen several specimens of *hesperis*, including an adult male taken in July, 1950, 12 miles east of Oakley, Summit County, Utah, which show a general reduction in the intensity of the dark feather pigments coupled with a striking increase in the abundance of large whitish or ashy dorsal blotches and vermiculations. Birds of this "dilute" type bear a superficial resemblance to extreme examples of *sennetti* yet are easily separable from them.

*Variation resulting from wear and fading.*—By late July the wing and tail feathers have noticeably faded and show signs of abrasion. The ground color of the dorsum has faded and some of the lighter terminal portions of the contour feathers have worn away so that the bird has a less mottled and generally paler appearance than it had earlier in the year.

Over a period of years there is considerable post-mortem color change, with the light parts of the plumage tending to become dusky and the dark parts browner and paler. Buffy and tawny hues often become rufescent. As a consequence, the contrasts between dark and light areas of the plumage are reduced and the specimen assumes a more uniform appearance. Specimens not adequately degreased are especially prone to change color. Differences resulting from these changes are readily noticeable between specimens collected at the same locality 10 years apart (for example, southern Idaho, 1940 and 1950) and much of the material collected prior to 1920 has so foxed as to be of limited value for color comparisons.

#### GEOGRAPHICALLY VARIABLE CHARACTERS

*Color and pattern.*—Geographic variation has resulted in a number of populations of racial stature, examples of which are easily recognizable by their general aspect (fig. 2), but the highly variegated pattern of the plumage does not lend itself to detailed analysis of specific characters. The important variables of the dorsum are: (1) the intensity and, to a lesser degree, the hue of the dark background; that is, the median portion of the contour feathers and large areas of the flight feathers, which may be black to dark ochraceous brown; (2) the shape, size, and abundance of light mottlings and vermiculations, including those of the upper wing and tail coverts and streaks of the nape; (3) the hue and intensity of these markings, which vary from white through light buff to dark tawny; (4) the amount of silvery wash on the dorsal surface of the primaries and the terminal portions of the rectrices; and (5) the size of the white wing patch and tail bar.

Geographically variable features of the ventral surface include: (1) the intensity and, to a lesser degree, the hue of the dark bars of the belly and crissum, which vary with the dorsal ground color; (2) the width of these bars; (3) the extent, intensity, and hue of the dark areas of the breast, which also vary with the dorsal ground color; (4) the color of the mottlings of the breast, which is usually the same as that of the dorsal mottlings; (5) the general tone of the under parts, particularly the posterior region, resulting for the most part from a suffusion of pale color which is most evident in the light areas between the dark bars (the suffusion is more noticeable in the female than in the male and varies from gray-buff to pale tawny); and (6) in the female, the color of the throat patch, which is similar to that of the dorsal mottlings.

The color, form, and abundance of the light dorsal markings are the most useful characters for readily distinguishing examples of the various races (fig. 2). The progressive lightening of the dorsal aspect from *minor* through *hesperis*, *henryi*, *howelli*, and *sennetti* is achieved by a widening of the light and somewhat irregular bars of the contour feathers. As they widen, the light bars are interrupted by small, dark splotches

which produce a vermiculiform pattern. The light bars of the rectrices show a similar widening. The light areas of the contour feathers and coverts are mostly tawny in *henryi*, buffy in *howelli*, and white or pale buff in *hesperis* and *sennetti*. In the accounts of subspecies which follow, capitalized names of colors are those of Ridgway (1912).

*Size*.—Wing length (chord) and tail length (from the insertion of the two central rectrices to the tip of the longest rectrix) are the most satisfactory measurements for study.

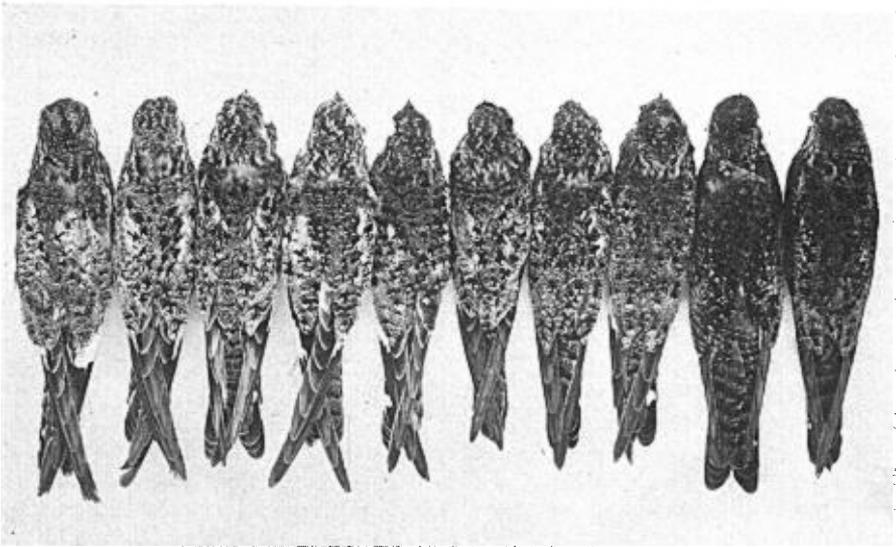


Fig. 2. Two adult males of each of the western North American races of *Chordeiles minor* shown in dorsal view. Left to right: *sennetti* (Colorado), *howelli* (Colorado), *henryi* (Colorado and México), *hesperis* (Idaho), and *minor* (British Columbia). Apparent size differences due largely to manner of preparation of skins.

For purposes of analyzing size variation the specimens were segregated into three groups as follows: (1) Juvenile; the tail is shorter than in any other group and the wing is shorter than in group 3. (2) Juvenal-winged first-year; there is, of course, no change in wing length over the juvenal plumage other than a slight decrease resulting from wear at the tip of the 10th primary; tail length is the same as in group 3. (3) Adult-winged first-year and adult; included in this group are (*a*) first-year birds which have replaced their juvenal primaries but which are recognizable by the retention of one or more juvenal secondaries and greater secondary coverts; wing length is intermediate between that of juveniles and true adults; also included are (*b*) true adults, that is, birds two or more years old, and, presumably, a number of first-year birds which have all adult remiges.

Because of difficulty in segregating mid-summer specimens with respect to subgroups 3*a* and 3*b*, the two necessarily were combined for measurement purposes. The wing length of breeding males, both adult and first-year, of *hesperis* from the northern Great Basin is presented in figure 3, where a marked bimodality of distribution is evident. Several of the smaller "adult" birds (wing 188 and 190 mm.) doubtless are first-year individuals which have replaced their juvenal primaries. The histogram of tail length of the same specimens shows an approximately normal distribution; it will be

recalled that immature nighthawks invariably molt their juvenal rectrices during the first winter.

In table 1 measurements of males of the various races are presented. Adult females average about 10 per cent smaller than adult males and juvenal-winged females are a like percentage smaller than juvenal-winged males. The data from adult males suggest

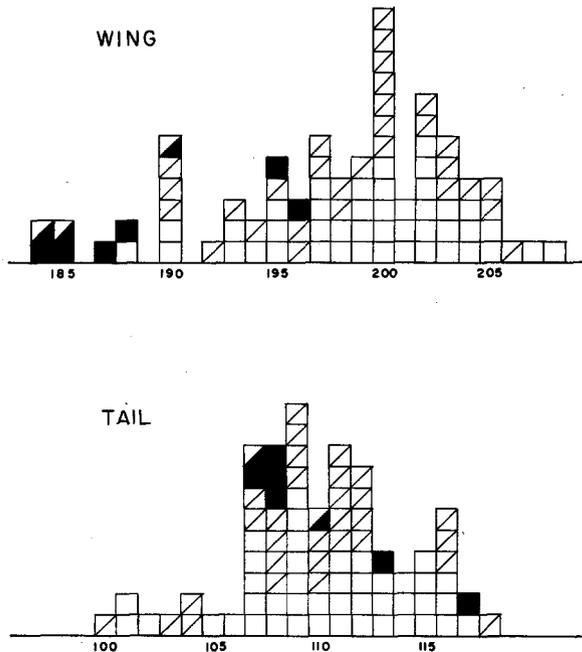


Fig. 3. Wing and tail length of male *Chordeiles m. hesperis* from southern Idaho (plain squares) and northern Utah (diagonally marked squares) in millimeters. Solid and half-solid squares represent first-year birds with juvenal primaries; open squares represent adult-winged birds.

some slight degree of north-south size differentiation in length of wing. Length of tail is more variable geographically, there being significant differences (at the level of non-overlap of two standard errors) between several of the sample means. In general this trend is for decreased size in eastern and southern races and increased size in western and northern populations.

#### MIGRATION AND SEGREGATION OF PROBABLE BREEDING INDIVIDUALS

It has not been generally recognized that spring migration of this species in the western states continues well into June and that fall migration often begins in the latter part of August. As a result, specimens taken in April, May, early June, and September frequently have been presumed to represent summer residents and have served as the basis for range allocations. At the outset of this study it became apparent that a careful screening of migrant birds from breeding birds would be necessary if a clear interpretation of geographic variation was to be achieved.

*Spring migration.*—Migrant Booming Nighthawks reach Brewster County, Texas, about May 20 (Van Tyne and Sutton, 1937:40). In Utah, according to Higgins (1948:

7-9), spring migration begins the last week of May and continues until "nearly the middle of June," with the peak of movement being reached by the end of the first week of June. His records over a seven-year period for first spring arrivals at Price, Carbon County, are between May 27 and June 2. Similar observations by C. W. Lockerbie (MS)

Table 1

Measurements in Millimeters of Males of *Chordeiles minor*

Locality	Age	No.	Wing			No.	Tail		
			Mean	Range	S.D.		Mean	Range	S.D.
<i>minor</i>									
Brit. Columbia,	ad.	11	199.9	(191-207)	4.9	11	111.8	(103-117)	3.9
N Wash.	1st yr.	4	195.0	(191-199)	....	4	110.7	(108-113)	....
<i>hesperis</i>									
S Idaho,	ad.	42	199.4	(188-208)	4.6	41	110.4	(102-117)	3.7
NW Utah	1st yr.	6	189.1	(184-196)	....	6	110.0	(107-116)	....
North-central	ad.	15	198.4	(190-205)	4.9	15	109.9	(100-116)	4.0
Utah	1st yr.	2	187.5	(185-190)	....	1	107	.....	....
Central Utah	ad.	16	198.9	(192-206)	4.3	16	109.8	(103-118)	4.0
	1st yr.	1	184	.....	....	1	110	.....	....
Walden,	ad.	6	201.8	(194-202)	....	6	110.1	(101-116)	....
Colorado	ad.	17	200.0	(195-206)	3.8	16	114.4	(109-120)	3.4
California	1st yr.	2	188.0	(186-190)	....	2	107.0	(105-109)	....
<i>henryi</i>									
Four Corners	ad.	19	196.0	(188-203)	4.1	20	109.1	(103-115)	2.9
region	1st yr.	6	183.0	(175-190)	....	6	107.0	(104-112)	....
S New Mexico,	ad.	6	202.1	(197-209)	....	6	111.8	(108-114)	....
S Arizona	1st yr.	4	188.0	(184-193)	....	3	105.7	(100-112)	....
Northern Mexico	ad.	1	191	.....	....	1	105	.....	....
	1st yr.	1	191	.....	....	1	112	.....	....
<i>howelli</i>									
Uinta Basin	ad.	12	197.6	(192-207)	4.1	12	109.4	(106-113)	2.2
	1st yr.	4	183.7	(184-196)	....	4	110.2	(107-114)	....
Eastern Colorado	ad.	14	197.4	(185-203)	4.1	13	109.3	(102-117)	4.3
	1st yr.	2	191.0	(191-191)	....	2	104.5	(104-105)	....
Weld County,	ad.	9	196.2	(189-204)	....	9	109.1	(104-116)	....
Colorado	1st yr.	1	182	.....	....	1	105	.....	....
<i>sennetti</i>									
NE Colorado,	ad.	4	199.0	(194-205)	....	4	107.0	(104-113)	....
E Wyoming	1st yr.	2	187.5	(183-192)	....	3	106.0	(104-108)	....
North Dakota,	ad.	17	196.1	(190-198)	4.1	18	107.2	(102-112)	3.3
Wisconsin	1st yr.	2	187.0	(185-189)	....	2	103.0	(101-105)	....
Saskatchewan	ad.	6	199.1	(195-206)	....	6	109.0	(106-114)	....

over a ten-year period at Salt Lake City are May 27 to June 8. Twomey (1942:401) recorded a migrant flock in the Uinta Basin, Utah, on May 14, 1937. In the Coeur d'Alene region of northern Idaho, Rust (1947:184) noted an average date of about June 6 for first arrivals over an eight-year period, with extremes of May 29 and June 18. Gullion (1951:140) recorded spring migration in "mid-June" (earliest date, May 9) in the southern Willamette Valley of western Oregon. Nighthawks have been recorded arriving in southern British Columbia and southern Alberta between May 28 and June 3 (Munro, 1945:70; Clarke and Cowan, 1945:93), and they reportedly are common in central Brit-

ish Columbia by June 10-12 (Munro, 1949:91; 1947:81). In 1938, Cowan (1939:34) noted the first arrival of this species in the Peace River region of northeastern British Columbia on May 29, and in 1921, Swarth (1924:344) first noted nighthawks at Hazelton, northern British Columbia, on June 3.

Both Rust (*op. cit.*:177) and Higgins (*op. cit.*:10) reported that females generally arrive on the nesting grounds a few days before the males.

*Fall migration.*—Migration in Utah begins in the last week of August and reaches a maximum of movement by the first week of September (Higgins, 1948:7-9). "Last seen" records by Higgins are October 11, 12, and 15. In northern Idaho fall movements usually begin in the last 10 days of August (Rust, 1947:187). Migration in the San Bernardino Mountains, California, was recorded on August 20, 1905, by Grinnell (1909:68). In central British Columbia in 1945, Munro (1949:91) observed the first migrants on August 8 and the main flight on August 20, and in 1944 he recorded the first migrants on August 9 (1947:81). Many of the young-of-the-year depart southward after the main flight of adults has taken place (Rust, *op. cit.*:187). Migrants taken in the western states in the latter part of September or later in the year are almost invariably immature.

There have been several reports of fall migration in the western United States in July. A highway census of supposedly migrant birds made near Grand Canyon, Arizona, on July 29, 1941, was reported by Bryant and Bryant (1941:293). Fifty-one nighthawks were seen from a car along an 18-mile strip of desert. Another concentration of nighthawks in Arizona was reported by Bryant and Bryant (1945:268) where 287 birds crossed the highway in eight minutes near Grand Canyon Junction on August 17, 1943. The large number of birds involved in this case indicates that an annual migration was taking place. Gullion (1951:140) stated that migration in the Willamette Valley, Oregon, begins "in late July." He noted "the peak in early September, with flocks of as many as 300 birds." In view of other reports on fall migration, however, I am inclined to question these July records as being instances of annual migration. In connection with this problem, it is noteworthy that numerous local movements of feeding flocks composed of apparently breeding birds to and from an area in the Hovenweep National Monument, Colorado, were observed by Hansen (1950) from July to September. Nighthawks frequently move between their nesting area and a favorable feeding location in groups which might be mistaken for migrating flocks.

In accordance with available migration data, the general rule was adopted of considering only those birds collected between June 15 and August 15 as having been on their breeding grounds; a procedure which was strictly followed whenever questions of racial boundaries were involved. In a few other instances, however, specimens taken prior to June 15 and after August 15 were included in the breeding series when, on the basis of subspecific characters, there seemed no reasonable doubt but that they represented the breeding population of the area in which they were taken.

#### SUBSPECIES ACCOUNTS

##### *Chordeiles minor minor* (Forster)

*Capr[imulgus] minor* Forster, 1771:13.

*Type locality.*—South Carolina.

*Range in western North America.*—Breeds in typical form in Canada south to central Saskatchewan and Vancouver Island and in atypical form south in the United States to north-central and western Washington and extreme northwestern Oregon; intergrades with *hesperis* in central Oregon (Newport, Corvallis, Sparks Lake, John Day River, Umatilla), southeastern Washington (Walla Walla County, Sprague), southeastern British Columbia (Okanagan Landing) and southern Alberta

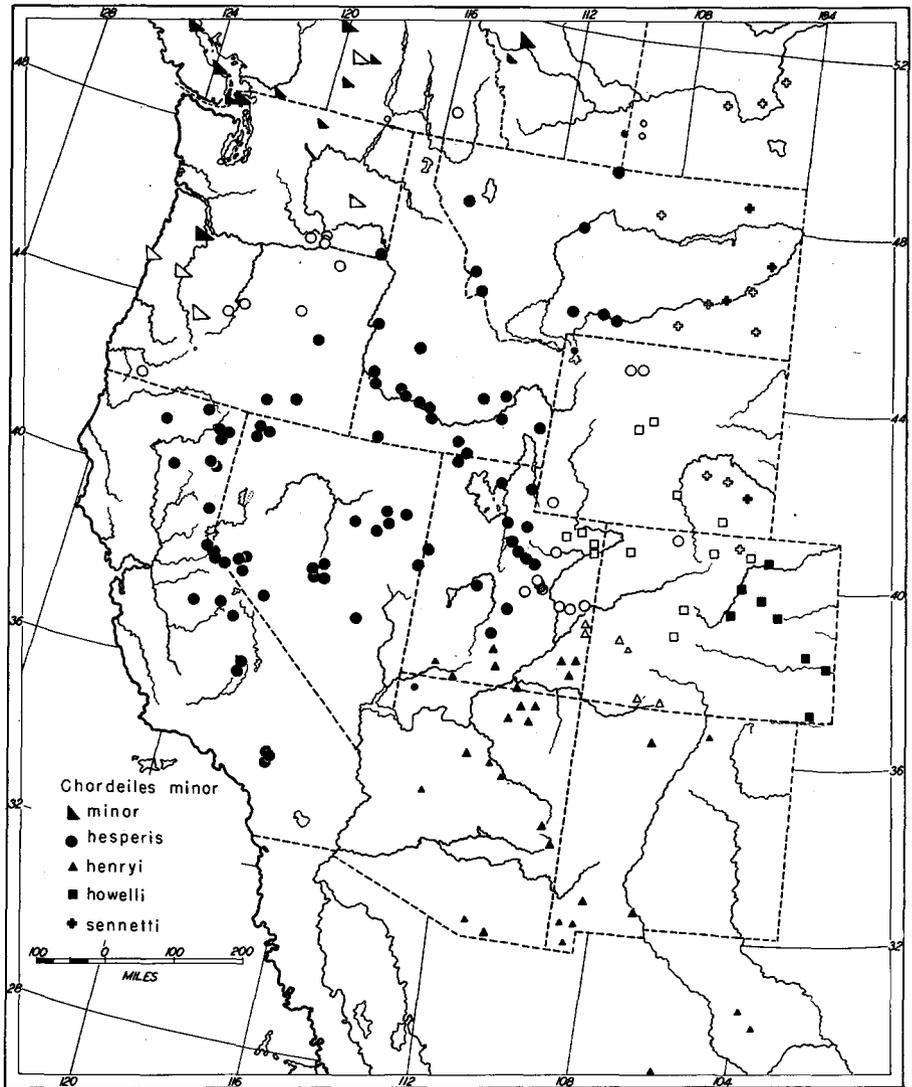


Fig. 4. Distribution of *Chordeiles minor* in western North America. Large symbols, specimens examined; small symbols, selected records from the literature. Open symbols represent inter-gradient samples.

(Didsbury). (See map, fig. 4.) Accidental at Point Barrow (Bishop, 1944:187) and Allaket (Murie, 1925), northern Alaska. Winters in South America, from Colombia and Venezuela south to Argentina.

*Characters*.—The darkest race occurring in western North America. Dorsal ground color usually intensely black, with the dorsal mottlings sparse, coarse, and mostly white or Cream Buff but often dark Ochraceous Buff or Tawny; streaks on nape and auricular region dark Ochraceous Buff; dark areas of the anterior under parts blackish with few dark buff spots or streaks; bars of the belly darker and wider than in other races; wing patch averages smaller than in other races, with possible exception of *henryi*; under parts washed with Warm Buff. Female differs from male in having the under

parts more conspicuously washed with buff, the dorsal ground color more brownish, and the light mottlings generally buffier or more tawny. Size rather consistently large (see table 1).

*Specimens examined.*—BRITISH COLUMBIA. Atlin, 4 (June-Aug.); upper Nicola River, 4000 ft., 2 (Aug.); Telegraph Creek, 3 (June); Stikine River, 1 (July); Hazelton, 959 ft., 2 (June); Clearwater P. O., 1 (June); Barriere, 1 (June); Comox, 2 (Aug.); Errington, 3 (Aug., Sept.); Okanagan Landing, 7 (June, Aug.; intergrades with *hesperis*); Fawcett, 1 (May). ALBERTA. Little Red River, Didsbury, 3 (June; intergrades with *hesperis*). WASHINGTON. San Juan County: Friday Harbor, 5 (June-Sept.). Lincoln County: Sprague, 1 (June; intergrade with *hesperis*). OREGON. Wallowa County: Wallowa Lake, 1 (June; migrant). Deschutes County: Sparks Lake, 5426 ft., 1 (July). Benton County: Corvallis, 1 (July). Lincoln County: Newport, 1 (June). Washington County: Beaverton, 3 (June, July; one specimen atypical toward *hesperis*). IDAHO. Ada County: Boise, 1 (June 11, 1942). UTAH. Weber County: Ogden Canyon, 4300 ft., 1 (May 29, 1952). Wasatch County: Midway Fish Hatchery, 5450 ft., Midway, 1 (June 9, 1944). COLORADO. Kiowa County: Eads, 1 (Sept. 13, 1941). Conejos County: Sanford, 1 (Oct. 2, 1943). Lincoln County: Limon, 1 (May 30, 1945). Weld County: Rockport, 1 (June 12, 1941).

*Remarks.*—Breeding birds from Okanagan Landing, British Columbia, although clearly referable to *minor*, approach *hesperis* in a number of their characters. The females, especially, differ from examples from northern British Columbia in having more abundant light dorsal mottlings, less blackish anterior under-parts, and narrower ventral dark bars. Most of the males more closely resemble *minor*, although one specimen is not unlike *hesperis* in coloration. According to Oberholser (1914:39), a series of *minor* from Ashcroft and single specimens from Lac La Hache and Chilliwack, southern British Columbia, also approach *hesperis*.

Two immatures having only partly grown flight feathers and another more fully grown immature from Okanagan Landing are *minor*, while two fully grown immatures collected there on September 5 and 17 are referable to *hesperis*. The latter two may have been vagrants from a more southern region. Another possible vagrant of *hesperis* from the same locality is an adult male taken on August 11.

Two adults and an immature from Cranbrook, southeastern British Columbia, are referable to *hesperis*, although they reflect some connection with *minor*. *Hesperis* has been reported from southeastern British Columbia by a number of authors (Oberholser, 1914:48; Brooks and Swarth, 1925:71; Munro and Cowan, 1947:134-135; and Rand, 1948:29).

Breeding birds from Little Red River, Didsbury, central southern Alberta, show a slight approach toward either *hesperis* or *sennetti* in their abundance of light mottling but, as a group, they are decidedly nearer *minor*.

In western British Columbia *minor* ranges south to the international border and into northwestern Washington without apparent intergradation with *hesperis*, as shown by a series of birds from Vancouver Island and Friday Harbor, San Juan County. A transition connecting *minor* with *hesperis* continues southward through western Washington and western Oregon (see page 72).

The paucity of migrant records of *minor* in the western states suggests that the major migration route of populations of this race breeding in western Canada is through the eastern United States. A few individuals, however, pass through some of the western states in both spring and fall; specimens have been obtained in Utah (Behle, 1948:71, and Behle and Selander, 1952:28), Colorado (Oberholser, 1914:43; also specimens examined herewith), and Idaho. Two specimens referred to *minor* by Friedmann, Griscom, and Moore (1950:152) were taken in Nayarit, México, on July 9, a date unusually late for spring migration.

### *Chordeiles minor hesperis* Grinnell

*Chordeiles virginianus hesperis* Grinnell, 1905:170.

*Chordeiles minor twomeyi* Hawkins, 1948:131 (see Todd, 1948, for correction of catalog number of type).

*Type locality.*—Bear Lake, 6700 feet, San Bernardino Mountains, San Bernardino County, California.

*Range.*—Breeds from southeastern British Columbia and southern Alberta south through southeastern Washington and eastern and southern Oregon, Idaho, western and central Montana, western Wyoming, extreme northern Colorado (west of the Front Range), central and western Utah, Nevada,

and California (Cascade-Sierra Nevada region and San Bernardino Mountains in southern California, *vide* Grinnell and Miller, 1944:209). Intergrades with *minor* in southern British Columbia, southern Alberta, southeastern Washington, and central Oregon; with *senneetti* in southern Saskatchewan and central Montana (east of the eastern slope of the Rocky Mountains); with *howelli* in south-central Wyoming (Fremont County) and northwestern Colorado (Jackson County); with *henryi* and *howelli* in the Uinta Basin of eastern Utah and western Colorado; and with *henryi* in southeastern Utah. Winter range unknown. Migrates through the southwestern states and casually east to Louisiana, Sonora, Campeche, and Nicaragua.

*Characters.*—Similar to *minor* but differs in having the ground color less intensely black; mottlings of the upper parts largely white, Light Buff, or Cream-Buff, finer, and much more abundant; nape streaks paler (often white); anterior under parts less blackish; ventral dark bars narrower and lighter; under parts less conspicuously washed with buff; wing patch larger, and light tail bars wider. Female similar to male but differs in having more buffy posterior under parts, the ground color occasionally lighter and more brownish; mottlings duller and less whitish, contrasting less sharply with the ground color. Size similar to *minor*.

*Specimens examined.*—BRITISH COLUMBIA. Burns Slough, 2950 ft., Cranbrook, 2 (Aug.); Cranbrook, 1 (Aug.); Okanagan Landing, 3 (Aug., Sept.). WASHINGTON. Asotin County: 6 mi. S Anatone, 1100 ft., 4 (July). Walla Walla County: Wallula, 1 (June); Snake River, 350 ft., 1 mi. N Burbank, 1 (July); 1 mi. "above" mouth Snake River, 350 ft., 1 (May). OREGON. Lake County: 9 mi. S Adel, 7 (May, June); Adel Lake, 1 (June). Malheur County: Beulah, 1 (June); Rome, 1 (June). Harney County: Alvord Lake, 1 (July); Burns, 2 (Aug.). The following Oregon specimens are intermediate between *hesperis* and *minor*.—Josephine County: 5 mi. E Cave Junction, 1 (July) (closely resembles *minor*). Deschutes County: Swampy Lake, 5700 ft., 13 mi. W, 3 mi. S Bend, 1 (June). Grant County: John Day River, 1 (June). Crook County: 4 mi. SW Prineville, 3300 ft., 2 (June). Umatilla County: Umatilla, 1 (July). Douglas County: Umpqua River, "near" Echo Lodge, 1 (Aug.). CALIFORNIA. Siskiyou County: Mount Shasta, 2 (July). Modoc County: Parker Creek, 5500 ft., Warner Mts., 1 (June); Squaw Mt., 1 (July); Alturus, 1 (Oct.); Crowder Flat, 5200 ft., 38 mi. NNW Alturus, 2 (June); Likely and "near" Likely, 2 (June); Eagleville, 2 (June, Sept.). Shasta County: 2 mi. SE Old Fort Crook, 3400 ft., 1 (July). Tehama County: Dales, 600 ft., on Paines Creek, 1 (May); Lymans, 3300 ft., 4 mi. NW Lyonsville, 1 (June); Dutch Flat, 3400 ft., 1 (Aug.). Sierra County: Loyalton, 1 (June). Placer County: Cisco, 1 (June). Nevada County: Donner, 1 (July). Lassen County: Petes Valley, 4500 ft., 1 (July); Eagle Lake, Spaldings, 7 (June, July). El Dorado County: Echo Lake, 8700 ft., 1 (June); Bijou, 2 (Aug.); Stateline, 1 (June). Alpine County: Hope Valley, 3 (Aug.); 2 mi. NE Woodfords, 5700 ft., 1 (June). Tuolumne County: Tuolumne Meadows, 1 (July); Sierra Nevada, 1 (June). Mariposa County: Dudley, 3000 ft., 3 (Aug.). Fresno County: Shaver Railroad Station, 5300 ft., 2 (July). Tulare County: Troy Meadows, 1 (Aug.); Trout Creek, 4 (July); Jackass Meadow, 7750 ft., 1 (July). Inyo County: Grays, Kearsarge Pass, 2 (June); Independence, 2 (July). Mono County: Leavetts Meadow, 1 (Aug.); 11 mi. S Benton Station, 1 (Aug.); 1¼ mi. ESE Leevining, 6450 ft., 1 (June). San Bernardino County: Bluff Lake, 7500 ft., 10 (July); Fish Creek, 9000 ft., 1 (June); South Fork Santa Ana River, 6200-7000 ft., 5 (June, July); Sugarloaf, 7500 ft., 1 (Aug.); Summit, 1 (Sept.). NEVADA. Humboldt County: Big Creek Ranch, 4350 ft., base Pine Forest Mts., 1 (June); Virgin Valley, 1 (June). Elko County: Harrison Pass R. S., Green Mt., 2 (June); W side Ruby Lake, 17 mi. N Elko County line, 2 (July). Eureka County: Winzell, 1 (June). White Pine County: Baker Creek, 8000 ft., 4 (July); 7 mi. SE Hobson P. O., 1 (July). Washoe County: mouth Little High Rock Canyon, 5000 ft., 1 (June). Lyon County: 6 mi. S Yerington, 4300 ft., 2 (June). Mineral County: E Walker River, 5100 ft., 2 mi. NW Morgans Ranch, 1 (July); 5.5 mi. NNW Sweetwater, 7400 ft., 1 (July); 2 mi. SW Pine Grove, 7250 ft., 2 (June). Esmeralda County: Fish Lake, 4800 ft., 2 (June). Nye County: Millet P. O., 5500 ft., 2 (Aug.); 1 mi. E, 1.5 mi. SE Jefferson, 7600-8600 ft., 2 (Aug.); Garden Valley, 8.5 mi. NE Sharp, 1 (June); Greenmonster Canyon, Monitor Range, 1 (July); Monitor Valley, 9 mi. E Toquima Peak, 7000 ft., 1 (July). IDAHO. Washington County: Weiser, 1 (June). Gem County: Montour, 4 (Aug.) (atypical, migrants?). Fremont County: 17 mi. E, 14 mi. N Ashton, 6275 ft., 1 (Aug.). Butte County: Big Butte, 2 (July); Birch Creek, 1 (Aug.). Bannock County: Pocatello, 1 (June). Bonneville County: 17 mi. W Idaho Falls, 2 (July). Cassia County: Elba, 2 (June); Stanrod, 2 (June, Aug.). Boise County: 7 mi. E Lowman, 1 (June). Owyhee County: Indian Creek, 5500 ft., 2 mi. SW Riddle, 2 (June). Elmore County: Ham-

mett, 1 (June); 4 mi. SE Kinghill, 1 (June); Glens Ferry, 6 (July); Mountain Home, 3 (July). Canyon County: Nampa, 2 (Aug.; atypical, migrants?); 2 mi. SW Melba, "Owyhee" County, 2 (June); Walters Ferry, 3000 ft., 5 mi. SW Melba, 12 (Aug.). Custer County: 3 mi. W Red Fish Lake, 1 (Sept.). Twin Falls County: Buhl, 9 (July). Gooding County: Hagerman, 5 (July). Caribou County: Blackfoot River Reservoir, 6000 ft., 1 (June). UTAH. Box Elder County: Junction Reservoir, 6200 ft., 3 mi. S Lynn, 12 (July); Johnson Creek, 5600 ft., 4 mi. S Yost, 3 (June); Duckville Gun Club, mouth Bear River, 1 (June); Hansens Island, mouth Bear River, 1 (Sept.). Juab County: Queen of Sheba Mine, 8000-8500 ft., Deep Creek Mts., 2 (July, Sept.). Tooele County: Rush Valley, south of Benmore, 1 (June). Rich County: Woodruff, 9 (Aug.). Salt Lake County: 4 mi. N Salt Lake City, 4250 ft., 1 (Aug.); Big Cottonwood Canyon, 1 (June; intergrade with *howelli*; migrant). Summit County: 12 mi. E Oakley, 7500 ft., 15 (July). Wasatch County: Parleys Park, 4 (June, Aug.); Midway Fish Hatchery, 1 (June). Utah County: Mount Timpanogos, 1 (July); Colton, 5 (Aug.); Provo, 1 (Sept.); 10-15 mi. E Thistle, 5300 ft., 3 (July); Castella, 4 mi. NW Thistle, 1 (June); Fairfield, 1 (June). Duchesne County: 5 mi. N Duchesne, 5. Carbon County: 3 mi. S Helper, 4; 3-4 mi. N Wellington, 7; 3 mi. N-3 mi. S-1.5 mi. SE Price, 4; Price River, 5500 ft., Price, 2 (Sept.); Soldier Canyon, 3; 3 mi. S Hiawatha, 5. Sevier County: junction Salina and Fish Lake roads, 3 (Aug.). Wayne County: Loa, 2; Fruita, 1 (June). Millard County: Oak City, 6 (Aug.). Iron County: Buckskin Valley, 1 (Sept.). Grand County: Elgin, 1 (Aug.); Segoe, 1 (Aug.); Cisco, 2 (July; intergrades with *henryi*). MONTANA. Sanders County: Camas Creek, 4 mi. S Fort Logan, 1 (Aug.). Ravalli County: Corvallis, 1 (July); "near" Sula, 2 (Aug.). Cascade County: Great Falls, 1 (July). Meagher County: 5 mi. NE Ringling, 1 (Sept.). Hill County: Milk River at 49° north latitude, 1 (July). Gallatin County: Bozeman, 1 (Aug.). Valley County: Johnson Lake, 1 (June 3, 1910). Stillwater County: Reed Point, 2 (June). Sweet Grass County: Big Timber, 2 (June). Beaverhead County: Birch Creek, 7100 ft., 18 mi. NW Dillon, 1 (July). Unlocated: Upper Geyser Basin, 1 (Aug.). WYOMING: Uinta County: Fort Bridger, 2 (June). Big Horn County: Greybull, 5 (June; breeding?); Germania, 2 (June). COLORADO. Jackson County: Walden, 7 (July; intergrades with *howelli*). The following Colorado specimens were probably migrants.—Lincoln County: Limon, 2 (Aug. 1, 1945). Kiowa County: Eads, 3 (May 28, 1941, Sept. 13, 1941, Sept. 24, 1939). Moffat County: Unspecified, 1 (June 3, 1924). Weld County: Greasewood, 1 (Aug. 12, 1939). Conejos County: Sanford, 1 (Oct. 2, 1943). Yuma County: Dry Willow Creek, 1 (Aug. 24, 1915). Unlocated: Henderson, 1 (Sept. 19, 1942). ARIZONA. Cochise County: Huachuca Mts., 1 (Aug.; migrant). MÉXICO. SONORA: 10 mi. S Nogales, 1 (Oct. 2, 1946).

*Remarks.*—In describing *twomeyi* from the Snake River region of southern Idaho, with type locality 2 miles southwest of Melba, 3000 feet, Owyhee [= Canyon] County, Hawkins (1948:32) remarked that it is "intermediate between *hesperis* and *sennetti* . . . [resembling] *sennetti* in the lightness of the underparts and *hesperis* in the darkness of the back." He listed four specimens, three from Idaho and one from Lake County, Oregon; one of these, according to Hawkins, shows "slight intergradation towards *hesperis*." He did not specify localities of material which he considered as *hesperis*.

For the present study I have had opportunity to examine 51 breeding birds from southern Idaho, including the type of *twomeyi*. The type is fairly representative of the average of that population as regards dorsal markings but is lighter than average ventrally. Series of skins from southwestern Idaho are not separable from series from northwestern Utah. Birds from Nevada differ slightly from Idaho specimens in having the dorsal mottlings more often cream-buff in color rather than predominantly white or pale buff. In addition, birds from Nevada show a wider range of individual variation in amount of light dorsal mottling than do those from Idaho and northwestern Utah, which are, as nighthawks go, remarkably uniform in this respect.

Birds from central and northern California are even more variable than those from Nevada, there being an increase in the number of variants having a reduced amount of light mottling, slightly wider ventral bars, and a suffusion of pale ochraceous buff ventrally and, to a lesser extent, among the dorsal mottlings. The type and paratypes of *hesperis* from the San Bernardino Mountains of southern California have faded and browned with age but are similar to specimens of like age from central and northern California.

It should be noted that there are no systematically useful size differences between birds from California and the Great Basin (table 1), although California specimens average a bit greater in length of tail.

Despite the fact that series of ten or more birds from California usually are separable from series of specimens from the Snake River drainage region, several circumstances argue against nomenclatural recognition of this differentiation. In the first place, segregation of mixed specimens from the two regions is on the order of only 70 per cent from 70 per cent. As an example, in working with series of 30 skins, if approximately 30 per cent (9 specimens) of the lightest California birds and a like percentage of the darkest specimens from Idaho were discarded, it was possible to correctly segregate the remaining birds with respect to locality. This degree of differentiation falls short of most standards currently advocated for subspecific separation (Rand and Traylor, 1950; Amadon, 1949), including the criterion of 90 per cent from 90 per cent suggested by Mayr, Linsley, and Usinger (1953:145) and is of a lesser order than that existing between currently recognized races of this species. Secondly, populations in western Montana and the mountainous regions of central Utah currently regarded as racially identical with those of the Great Basin show a darkening which parallels that of California birds (page 71).

Progressing northward from California into Oregon, a situation is encountered wherein birds from the eastern part of Oregon (Lake County) are uniformly like those from Idaho, whereas specimens from the extreme northwestern part of the state are highly variable but referable to *minor* by reason of their dark ground color, marked reduction in amount of light dorsal mottling, and increased width and darkness of their ventral bars. Specimens are available from the central part of the state which are intermediate to varying degrees between *hesperis* from southern Idaho and *minor* to the north in British Columbia (see map, fig. 4). These birds resemble some of the darker California specimens. An adult female taken on July 25 in Josephine County, Oregon, just north of the California border, resembles typical *minor* but is at present perhaps best regarded as an extreme variant of *hesperis*.

The situation apparently is similar in Washington. Of six specimens available from the southeastern part of the state (Walla Walla and Asotin counties), four are like *hesperis*, one is intermediate between *minor* and *hesperis*, and another is not unlike some lighter examples of *minor*. A bird from Sprague, Lincoln County, in the east-central part of the state, is very dark dorsally and has unusually wide ventral bars, being, on the whole, more like *minor* than *hesperis*. Farther to the northwest, in San Juan County, typical *minor* occurs as mentioned in the account of that race. *Minor* also has been reported from the northern Cascade Mountains (Burdick, 1944:239).

Two adult males from Nampa, Canyon County, Idaho, August 23, 1913, an adult female from 3 miles west of Red Fish Lake, Custer County, Idaho, September 7, 1947, and four birds (two adult males and two females) from Montour, Gem County, Idaho, August 20, are quite unlike the breeding birds of southern Idaho in that they show a marked reduction in the amount of light mottling. Considering the dates of their collection, it is probable that they were migrants, presumably from an area of intergradation between *hesperis* and *minor*.

The eastern limits of distribution of *hesperis* are discussed beyond in connection with the distribution of *howelli* and *sennetti*.

### *Chordeiles minor henryi* Cassin

*Chordeiles Henryi* Cassin, 1855:239.

*Type locality*.—Fort Webster, [Dona Ana County,] New Mexico.

*Range*.—Breeds from central-northern México (southern Durango) north through Arizona, New Mexico, and extreme western Texas to southeastern Utah (Wayne and Garfield counties, La Sal Mountains) and southwestern Colorado (Mesa County), where intergradation with *hesperis* and *howelli* occurs. Accidental (?) near Minco, Oklahoma (Wetmore, 1918:7). Winter range unknown; presumably South America; migrant records from Texas, Louisiana, México, and British Honduras (Austin, 1929:367); there is a June record from Colombia.

*Characters*.—Somewhat similar to *hesperis* but differs in having the ground color browner and more rufescent, less intensely black; dorsal mottlings coarser and mostly Tawny or Cinnamon-Rufous instead of white or Light Buff; under parts usually extensively suffused with buff or light Tawny; anterior under parts more rufescent, near Cinnamon-Rufous, less blackish, and usually spotted with Tawny, and the bars of the under parts averaging narrower and lighter, more rufescent; size of wing patch variable, but most frequently smaller than in other races, being especially reduced on 9th and

10th primaries where white often is restricted to the inner web even in adult-winged birds. Similar also to *howelli* but differs in a number of characters mentioned in the diagnosis of that race (page 74). Female dorsally much like male but usually has a more extensive and intensive suffusion of buff on the posterior under parts. Size similar to *howelli*.

*Specimens examined*.—MÉXICO. CHIHUAHUA: Colonio Pacheco, 2 (April, June); Río Gavilán, 6700 ft., 7 mi. SW Pacheco, 4 (July, Aug.). DURANGO: 29 mi. WNW Ciudad Durango, 1 (July); 30 mi. W Ciudad Durango, 8000 ft., 1 (June). COLORADO. Mesa County: Escalante Forks, 2 (July). La Plata County: Animas River, 5 (June). Archuleta County: "near" Navajo River, 1 (July). NEW MEXICO. Curry County: 4 mi. W, 3 mi. N Clovis, 1 (Aug.; migrant?). Grant County: Apache, 1 (Aug.). Dona Ana County: Radium Springs, 2 (June). Hidalgo County: Double Adobe, 1 (June; intergrade with *howelli*; migrant?). Rio Arriba County: 18 mi. E Cuba, 4 (Aug.). ARIZONA. Cochise County: Huachuca Mountains, 8 (June-Aug.). Coconino County: Red Lake (Tonales), 5800 ft., 1 (July); 38 mi. N Flagstaff, 6500 ft., 2 (Aug.); 3 mi. S Dry Park R. S., Kiabab Forest, 1 (June). Navajo County: Shonto Canyon, 6600 ft., 2 mi. SE Trading Post, 1 (July); Kayenta, 5800 ft., 1 (July); Black Mesa, 1 (Aug.). Apache County: White Mts., 22 mi. E Alpine, 1 (Aug.); Three Forks, 8300 ft., 20 mi. S Springerville, 1 (June). UTAH. San Juan County: 5 mi. SE Navajo Mt., 1 (June); Navajo Mt., 10,500 ft., 1 (July); La Sal, 4 (Aug.); Jackson Ridge, 25 mi. N Blanding, Abajo Mts., 2 (July); Blanding, 1 (Aug.); 9 mi. N, 14 mi. E Monticello, 10 (July, Aug.); Geyser Pass, La Sal Mts., 1 (July). Kane County: 3 mi. S Kanab, 2 (June). Wayne County: Donkey Lake, Boulder Mts., 1 (July). Garfield County: 10 Mile Spring, "south" Escalante, 1 (June); 5 mi. W Boulder, 6500 ft., 5 (July). Grand County: Warner Ranger Station, La Sal Mts., 4 (July). TEXAS. Brewster County: Marathon, 2 (May). Hidalgo County: Pharr, 1 (April).

*Remarks*.—Oberholser (1914:65) restricted the name *henryi* to the dark, tawny birds of the southwestern United States and México. His basis for the inclusion of southwestern Colorado within the range of this race was a specimen from Montrose, Montrose County. Specimens were not then available from southern Utah. Subsequently, Benson (1935:433) listed a specimen of *henryi* from Navajo Mountain, San Juan County, Utah, and Hayward (1940:94-95) advocated extending the range of *henryi* northward in Utah to the Uinta Basin (see page 76). Woodbury and Russell (1945:59) referred breeding birds of the Navajo country of southeastern Utah and northeastern Arizona to this subspecies.

These specimens, along with additional unreported material, have been examined in connection with the present study. Those from northeastern Arizona and Navajo Mountain, San Juan County, Utah, are "good" *henryi* and are rather uniform in appearance. Northward from the Utah-Arizona border, variability increases with evidence of an approach toward *hesperis*. A specimen from Boulder Mountain, Wayne County, and six birds from Garfield County are *henryi*, as are two from near Kanab, Kane County. Birds from Blanding and Monticello, San Juan County, are variable but, as a group, can be placed with *henryi*. About half of them verge toward *hesperis* in having an increase in the amount of light buffy mottling (as compared to the more tawny hue of *henryi*) and a reduction in the intensity of the buffy wash on the under parts. Some specimens thus closely resemble browner examples of *hesperis* from the Great Basin.

Specimens from La Sal, San Juan County, and the La Sal Mountains, Grand and San Juan counties, and Cisco, Grand County, also are intermediate, with some tendency for reduction of buff ventrally. One from La Sal is much like *hesperis*, for the most part lacking any tawny, and another from the same locality is intermediate between *howelli* and *henryi*. Two from the La Sal Mountains are like *howelli* and were so identified by Oberholser in 1938, apparently at the same time that he identified two other specimens from the same locality as *henryi* (Hayward, 1940:95). The occurrence of these variable birds in the region of the La Sal Mountains was interpreted by Hayward (*loc. cit.*) as indication of an overlap of the breeding ranges of *hesperis*, *howelli*, and *henryi* so that the three races breed in the same geographic area. However, in the absence of evidence of altitudinal segregation which would permit such an overlap and in view of the fact that birds from this region are no more variable than certain populations in western Colorado, Wyoming, and south-central Montana, they should be referred to only one subspecies. Taken as a group, then, these specimens average closest to *henryi*, to which race they may be allocated.

A bird from Segó, central Grand County, Utah, and one from Elgin, Grand County, are referable

to *hesperis*. Two from Cisco, Grand County, also are like *hesperis* but are browner than examples of that race from the Great Basin. Further work may show that the majority of birds from central Grand County are nearer *henryi* since birds of the Uinta Basin to the north seem to show a connection with that form (see page 75); but on the basis of material presently available, I have assigned birds from central and western Grand County to *hesperis*.

Two partly grown immatures from Escalante Forks, Mesa County, Colorado, are tawny dorsally and represent *henryi*, indicating that this is the breeding form in southwestern Colorado. Specimens from Animas River, La Plata County, and Navajo River, Archuleta County, just north of the Colorado-New Mexico border also are referable to *henryi*.

Burleigh and Lowery (1940:104) indicated that *howelli* is the breeding race of the Guadalupe Mountain region of western Texas on the basis of specimens collected on June 9, 12, and 17. However, at least the first of these dates is too early in the year to preclude the possibility of the birds being migrants. It should be noted that *henryi* reportedly is the breeding form in Brewster County, to the south, where *howelli* is a spring migrant (Van Tyne and Sutton, 1937:40-41).

Within the range of *henryi* there is a north-south cline in color. As noted by Oberholser (1914:66), breeding birds from México represent the extreme differentiation of the race in being consistently darker than birds from northern Arizona and New Mexico. This gradient is even more apparent now that specimens are available from as far south in México as southern Durango (Webster and Orr, 1952:310). The darkness of these southern birds involves an increase in intensity of the ground color, tawny markings, ventral bars, and general suffusion of buff or tawny ventrally. Progressing northward these features tend to lighten until the extreme in this direction is achieved in the Colorado Basin region of Utah and Colorado where transition to *hesperis* and *howelli* occurs.

#### *Chordeiles minor howelli* Oberholser

*Chordeiles virginianus howelli* Oberholser, 1914:57.

*Type locality*.—Liscomb, Liscomb County, Texas.

*Range*.—Breeds in typical form in north-central Texas, central and western Oklahoma, western Kansas, and eastern Colorado; in less typical form in central Colorado, northeastern Utah (Uinta Basin), and south-central Wyoming. Intergrades with *henryi* in southwestern Colorado; with *hesperis* and *henryi* in the Uinta Basin of northeastern Utah and northwestern Colorado; with *hesperis* in north-central Wyoming (Fremont County) and extreme northern Colorado (west of the Front Range); and with *sennetti* in northeastern Colorado (Weld and Morgan counties). Winter range unknown; presumably South America. Migrates through the central southern states (casually east to Louisiana and Mississippi), Campeche, México, and Nicaragua.

*Characters*.—A variable race, more or less intermediate between *henryi* and *sennetti*. Differs from *sennetti* in having the ground color more brownish-rufescent (less grayish-black), dorsal mottlings much more buffy or ochraceous (Ochraceous Buff), under parts buffier throughout, and the anterior areas of the under parts more ochraceous (less blackish gray). Differs from *henryi* in having the ground color slightly browner (less blackish), dorsal mottling more abundant, finer, and less deeply buffy or tawny, ventral bars lighter and narrower (often broken posteriorly), under parts lighter (less tawny), and wing patch larger. The female is quite unlike the male dorsally in that the mottlings are almost entirely deep buff instead of pale buff and whitish. Additionally, the female is usually darker below than the male, being quite similar in this respect to the female of *henryi*. Size about intermediate between *sennetti* and *hesperis*.

*Specimens examined*.—COLORADO. Unspecified, 2 (June). Baca County: Jimmie Creek, 1 (May); Campo, 2 (May, Aug.). Prowers County: Holly, 4 (May, Aug., Sept.). Kiowa County: Eads, 9 (May, Aug.). Yuma County: Wray, 1 (May). Morgan County: Jackson Reservoir, 7 (May, July, Aug.). Larimer County: Estes Park, 2 (Aug.; atypical; breeding?). Adams County: Barr, 3 (June, Aug.). Arapahoe County: Deer Trail, 1 (May). Denver County: Denver, 2 (July, Oct.). Douglas County: Jarr Canyon, Sedalia, 1 (July). Weld County: unspecified, 1 (July); Pierce, 9 (July); Greasewood Lake, 3 (June, July; intergrades with *sennetti*). Lake County: 3 mi. S Leadville, 10,000 ft., 1 (June). Chaffee County: Clear Creek, 1 (June). Gunnison County: Tincup, 3 (July; atypical). WYOMING. Albany County: Laramie River, 1 (Aug.); Laramie Peak, 2 (June). Fremont County: "N of" and "near" Sandraw, 3 (June); 8 mi. E by S Lost Cabin, 1 (June; atypical toward *hesperis*).

Carbon County: Saratoga, 1 (June); 25 mi. E, 10 mi. S Saratoga, 9800 ft., 1 (Sept.). UTAH. Box Elder County: Hansens Island, mouth Bear River, 1 (Sept.; migrant). Duchesne County: Timothy Creek, 7500 ft., 10 mi. N Altonah, 4 (June). Uintah County: 2 mi. S Vernal, 1 (Aug.); Vernal Game Refuge, 5500 ft., 3 mi. S Vernal, 1 (Sept.); 7 mi. N Vernal, 1 (Aug.); 3 mi. E Vernal, 7 (Aug.); Jensen, 3 (July). Carbon County: 3 mi. S Helper, 1 (Aug.; migrant?). Wayne County: Loa, 1 (Sept.; migrant). Salt Lake County: Salt Lake City, 1 (Sept.; migrant); mouth Big Cottonwood Canyon, 1 (June; migrant). Wasatch County: Midway Fish Hatchery, 5450 ft., 3 (June; migrants). Washington County: junction Virgin and Santa Clara rivers, 2700 ft., 2 mi. S St. George, 1 (Sept.; migrant). TEXAS. Brewster County: 4-20 mi. S Marathon, 5 (May; migrants).

*Remarks.*—Material examined in connection with the present study indicates that the light, buffy population which Oberholser (1914:57) named *howelli* extends westward in typical form only to eastern Colorado. In central and western Colorado, central Wyoming, and south-central Montana a complex situation exists with regard to the distribution of racial characters. Samples from these areas are so highly variable that breeding individuals resembling any one of the western races frequently are collected at the same locality. Oberholser (*op. cit.*:58-59) referred birds from these areas to *howelli*, but his limited material could not reveal the full complexity of variation.

In Utah the lightly mottled, dark ground-colored race *hesperis* occupies all of the Great Basin part of the state (page ....) and extends eastward in fairly typical form through the Wasatch Mountains. In extending the range of *howelli* west to the Wasatch Mountains of central-northern Utah, Oberholser (*op. cit.*:59) referred to that race four specimens collected by Robert Ridgway at Parleys Park (Kimballs Junction-Snyderville area, Summit County) in 1869. I have examined two of these and find that one is more like *hesperis* than *howelli* and the other is somewhat buffier dorsally than most examples of *hesperis* from the Great Basin. Both of these specimens have, however, foxed considerably so that an accurate evaluation of their characters cannot be made. It is evident that they bear no close relationship to populations of *howelli* in eastern Colorado since a series of 15 specimens recently collected at a locality directly east of Parleys Park, namely 12 miles east of Oakley, Summit County, is very similar to series of *hesperis* from Idaho and western Utah. Several males, however, have their under parts more noticeably suffused with pale buff and the mottlings of the dorsum and anterior lower parts less numerous and decidedly buffy. The darkness and buffiness of these birds parallels the variation of California specimens of *hesperis* (page 71).

A series of nine specimens from Woodruff, Rich County, about 60 miles north of Oakley, shows comparatively little individual variation and is representative of *hesperis*. Birds from near Colton, Thistle, and Hiawatha, Utah County, all of which localities are in a line south of Oakley, also are *hesperis*, although one variant, a male from 4 miles northeast of Thistle, resembles typical *howelli* from eastern Colorado.

Farther to the east within the Uinta Basin of northeastern Utah and northwestern Colorado individual variability increases, with an increased frequency of occurrence of buff in the dorsal mottlings. This variability is perhaps in part a result of the meeting of populations of *hesperis*, *howelli*, and, possibly, *henryi* in that area. This has been noted in the literature of the birds of that region. For example, Hayward (1940:94) recorded as *henryi* a breeding female with two juveniles from Jensen, Uintah County. The adult bird is indistinguishable from many examples of *henryi* from Arizona while the immatures are intermediate between *howelli* and *henryi*, showing many tawny markings characteristic of the latter race. On the basis of 11 specimens, six of which may be assumed to have been breeding, Twomey (1942:401) referred birds of the Uinta Basin to *howelli*. Most of these specimens are like *howelli* but are somewhat darker ventrally and have less numerous dorsal mottlings than do typical examples of that race. Twomey also collected a specimen which was called *henryi* from a large flock at Elk Springs on July 23, 1937. Two others collected from the same flock were assigned to *howelli*. He remarked (*op. cit.*:402) that "the nesting ranges of *howelli* and *henryi* meet approximately in the region of the Uinta Basin." The specimen from Elk Springs is a first-year bird which is abnormal in several respects. It was sexed as a male and has the well defined white throat crescent of that sex but lacks a subterminal tail bar. As regards size it is exceedingly small (wing 173 mm., tail 97 mm.) and is, in fact, the smallest first-year specimen of this species I have examined. In general coloration it resembles *henryi*.

Further evidence of the variable nature of the Uinta Basin population is supplied by three males

and four females from near Vernal, Uintah County. The females resemble *howelli* in having a brown cast to the ground color and predominantly buffy mottlings, but these markings are rather coarse and sparsely distributed, suggesting *henryi*. The males, however, are much like Great Basin birds (*hesperis*) from which they differ in having a lighter ground color and a faint wash of buff ventrally. In these characters they approach either *howelli* or *henryi*.

Another interesting case of variation of birds in this region is shown by four specimens from Timothy Creek, 10 miles north of Altonah, Duchesne County. Two females are essentially like *henryi*, one male is fairly typical of *hesperis*, although the ground color is rather light, and the other male has an unusual abundance of light mottlings and resembles *sennetti*.

Specimens from near Duchesne, Duchesne County, are referable to *hesperis* but are variable and have too light a ground color for that race. Females from this locality are buffier than typical examples of *hesperis*.

Series from Carbon County (Helper, Price, Wellington), south of the Uinta Basin, indicate the occurrence there of a very heterogeneous population. Some birds are nearly typical *hesperis* while others show a considerable abundance of buffy dorsal mottlings. The ground color of the latter group is rather dark, suggesting that their buffy mottlings result from an affinity with *henryi* rather than *howelli*. As a group birds from this region are referable to *hesperis*.

In summary, the range of *hesperis* may be extended eastward in Utah to Duchesne. The buffiness evident in the majority of birds from the eastern part of the Uinta Basin could represent intergradation between *hesperis* and *howelli*, *hesperis* and *henryi*, or a combination of the three. The occurrence there of a number of females approaching *henryi* would seem to indicate that the influence of that race is a factor. I have, nevertheless, assigned all breeding birds from the eastern Uinta Basin to *howelli*, since the majority of them most closely resemble that form.

Specimens from the mountainous central part of Colorado (Gunnison and Chaffee counties) differ from eastern Colorado birds in having a lesser amount of mottling and a reduction in intensity of buffiness both dorsally and ventrally. Several specimens resemble *hesperis* more closely than they do *howelli*.

I have examined an interesting series taken in July just west of the Front Range, at Walden, Jackson County, Colorado. The five males agree closely in their characters with Idaho birds although buffy mottlings are more prevalent and the majority of the specimens have a slightly browner shade to the ground color. The lone female of the series does not differ significantly from *howelli* from eastern Colorado. The fact that these birds were collected in July would tend to rule out the possibility of their having been migrants. Two specimens from Estes Park, Larimer County, central northern Colorado, taken on August 3, are very dark and have sparse mottlings. They were considered as migrants of *hesperis* by Oberholser (1914:50) but it is more probable that they were breeding inasmuch as they are similar to birds from Chaffee and Gunnison counties.

Material from Wyoming shows the same high degree of variability seen in that from western Colorado and eastern Utah. Four birds are available from Fort Bridger, Uinta County, in the southwestern corner of the state. They were referred by Oberholser (1914:64) to *howelli*, although he (*op. cit.*:60-61) mentioned three of the four as examples of extreme individual variation, commenting that one is "much like some specimens of *hesperis*," another is "somewhat like . . . *hesperis*," and still another "very much resembles . . . *sennetti*." I have examined two of these specimens; one is like *hesperis* and the other inclines toward *howelli*. Two specimens from Carbon County, central southern Wyoming, are similar to the Fort Bridger specimens but they may have been migrants (Oberholser, *op. cit.*:49). Four from central Wyoming (Fremont County) are intergradient between *hesperis* and *howelli* but nearer the latter, as are specimens from Laramie Peak and Laramie River. A series taken between June 14 and 20 at Greybull and two specimens from Germania, northern Wyoming, may not represent the breeding population, but in any event the specimens are highly variable, individuals resembling *hesperis* (or *minor*), *howelli*, and *sennetti* being present. Specimens from Yellowstone Park have been referred to *hesperis* (McCleary, 1939).

In Montana birds from along the western border are similar to California specimens of *hesperis*. Those from the central part of the state are highly variable, showing nearly the full range of variation of all the western races. For example, one from Crow Agency, Big Horn County, is typical *sennetti*, one from 12 miles southwest of Powderville, Powder River County, approaches *minor*, another from

the same locality is intermediate between *sennetti* and *howelli*, and one from 5 miles south of Forsyth, Rosebud County, is like *hesperis*.

The application of racial names to birds from the Rocky Mountain region is difficult. However, it seems advisable to refer all breeding birds from eastern Montana to *sennetti* and to draw the boundary between that subspecies and *hesperis* in that state along the eastern edge of the Rocky Mountains. As for Wyoming and western and northwestern Colorado, individual specimens and series have been provisionally assigned to the neighboring race which they most closely resemble (see map, fig. 4) and no attempt has been made to draw definite racial boundaries.

### *Chordeiles minor sennetti* Coues

[*Chordeiles popetue*] *Sennetti* Coues, 1888:37.

*Type locality*.—50 miles west of the Pembina Mountains, [Towner County (?),] North Dakota.

*Range*.—Breeds in southern Saskatchewan, extreme southwestern Manitoba, North Dakota, South Dakota, northwestern Iowa, northern Nebraska, eastern Montana (east of the Rocky Mountains), eastern Wyoming, and extreme northeastern Colorado (east of the Front Range). Intergrades with *minor* in central Saskatchewan and southwestern Manitoba; with *hesperis* in central Montana and central Wyoming; and with *howelli* in northeastern Colorado (Weld County). Winter range unknown. Migrates through Colorado, Texas, and Oklahoma, casually east to Ohio and Florida; there is an October record from Panamá (Griscom, 1932:328).

*Characters*.—The palest western North American race. Similar to *hesperis* but differs in having a lighter (less intensely black) ground color which usually is restricted to the subterminal portion of the contour feathers; mottlings, including those of the nape, more abundant, finer, lighter (ashy white and Light Buff), and more vermiculiform; anterior under parts grayer; ventral dark bars narrower and lighter and often broken in the extreme posterior region. Female differs from the male in having a lighter and more brownish ground color, mottlings duller, coarser, and more tinged with Light Buff (not so whitish), anterior under parts more brownish (less grayish), and the posterior under parts washed with grayish-buff, thus often resembling female *hesperis*. Tail length averages shorter than in *minor* and *hesperis*.

*Specimens examined*.—SASKATCHEWAN. Imperial, 3 (June); 3 mi. W Elbow, 2 (June); 12 mi. SW Davidson, 1 (June); 6 mi. W Amazon, 1 (June). COLORADO. Weld County: Grover, 1 (July); atypical variant; Rockport, 6 (July; intergrades with *howelli*). Douglas County: Parker, 2 (Sept. 20, 1936; migrant). Denver County: City Park, Denver, 1 (Sept. 25, 1913; migrant). Adams County: Barr, 1 (Aug. 8, 1910; migrant). Prowers County: Holly, 1 (Sept. 18, 1916; migrant). Yuma County: Dry Willow Creek, 1 (Aug. 18, 1915; migrant). Unlocated: Henderson, 1 (Sept. 19, 1942). WYOMING. Platte County: Uva, 1 (July). Albany County: Little Medicine, 2 (Aug.). MONTANA. Valley County: Strater, 2 (July). Dawson County: Darnalls, 30 mi. S Glasgow, 1 (July). Custer County: Fort Keogh, 1 (June); 3 mi. S Miles City, 1 (June). Phillips County: Ruby Creek, Zortman, 1 (July). Big Horn County: Crow Agency, 1 (July). Prairie County: Terry, 4 (June). Powder River County: 12 mi. SW Powderville, 2 (June; atypical). Rosebud County: 5 mi. S Forsyth, 2750 ft., 1 (June). Unlocated: Lismas, 2 (June). NORTH DAKOTA. Souris River, 1 (Aug.). Pembina County: Pembina, 1 (June). Dickey County: Oakes, 2 (July). McHenry County: 8 mi. N Towner, 2 (Aug.); Drake, 1 (Aug.). Morton County: Fort Rice, 2 (June); Glen Ullin, 2 (July). Emmons County: Linton, 1 (June). Ward County: Kenmare, 2 (July). Mountrail County: 6 mi. N Lostwood, 6 (Aug.). Burleigh County: Bismark, 1 (July). Unlocated: Sentinel Butte, 1 (June). IOWA. Boone County: 4 mi. SE Boone, 1 (Oct.; migrant). NEBRASKA. Keya Paha County: Carns, 1 (July). WISCONSIN. Dane County: Madison, 2 (June).

*Remarks*.—Individual variation in this race is especially marked and while the majority of birds are easily separable from *hesperis*, many individuals approach *hesperis* in having a reduction in the amount of dorsal mottling. In the other direction extreme examples of *sennetti* have their light vermiculations so numerous as to all but eliminate the ground color.

The extension of the breeding range of *sennetti* into northern Colorado (see map, fig. 4) is based on a series of six specimens, five males and one female, taken at Rockport, Weld County, on July 11 and 19. They are not quite typical of that race, however, in that certain of them show an approach toward *howelli* in having some buffy dorsal markings. The female is more like *howelli* than *sennetti*.

A short distance to the south of Rockport, at Pierce, Weld County, and Jackson Reservoir, Morgan County, the breeding birds also are intergradient but are referable to *howelli*; and still farther south, at Barr, Adams County, typical *howelli* occurs. Hence, the transition between the two races takes place over a relatively limited area.

The extreme development of racial characters occurs in North Dakota, with a transition to darker birds taking place across eastern Montana which finally connects with populations of *hesperis* in central Montana. This darkening involves an increase in intensity of the ground color, a reduction in amount of dorsal mottling, and an increase in width and darkness of the ventral bars.

Oberholser (1914:48) stated that breeding birds from Maple Creek and Indian Head, southern Saskatchewan, "incline somewhat toward *sennetti*, but are clearly . . . *hesperis*." Subsequently, Mitchell (1924:111), Todd (1947:406), and Godfrey (1950:42) considered *sennetti* to be the breeding race of that area. I recently examined seven of the specimens reported by Todd (*loc. cit.*). They are certainly referable to *sennetti* by reason of their abundant fine white vermiculations and light under parts but differ from examples of that race from North Dakota in having a darker ground color. In this latter respect they approach either *minor* or *hesperis*.

The inclusion of *sennetti* in the Utah check-list as a transient (Behle, 1944:76, and Woodbury, Cottam, and Sugden, 1949:17) is based on a specimen reported by Hayward (1940:94) from Provo, Utah County, collected on August 29, 1931, and another taken by Twomey (1942:402) near Jensen, Uintah County, on September 21, 1937. Both specimens are juvenal and neither is light enough dorsally to be confidently referred to *sennetti*. The one from Uintah County does not differ from many juveniles of *hesperis* from California and Nevada and is darker both ventrally and dorsally than some of them. The Provo bird is more like the present race but is matched by several examples of *hesperis* and may be merely a light specimen of that race. *Sennetti* eventually may be taken in Utah as it is a rather common transient in Colorado.

#### DISCUSSION

Booming Nighthawks in the western United States range altitudinally from tree line down to the lower limits of the Upper Sonoran Zone. They are replaced in the Lower Sonoran Zone by the Trilling Nighthawk (*Chordeiles acutipennis*). This altitudinal separation apparently breaks down in México but adequate data on the distributional relationships of the species in that region are not available. Within the wide vertical range occupied by *Chordeiles minor*, this species frequents open areas such as rocky slopes and ridges and burned-over patches and other clearings in stands of coniferous forest. It is especially abundant in the piñon-juniper forests of the southern Rocky Mountains and Great Basin (not true in California, see Miller, 1951:550) where, because of the spacing of trees and lack of shrubby undergrowth, large areas of bare ground are available. Sagebrush areas provide habitat of a similar type and flat, gravel-covered roofs of buildings also commonly are used for nesting.

The eggs are incubated in a shallow depression on the ground and the adult birds are inactive during the greater part of the day, either resting on the ground or perching on larger tree branches or similar structures. Concealment is provided by the color and mottled pattern of the dorsum which tends to resemble the background and by the barred under parts which serve to break up the body outline. This camouflaging effect of color and pattern is enhanced by a habit of "freezing" with head elevated and extended when alarmed. Geographic variation in color and pattern evidently is an adaptation to differences in the general aspect of soil and vegetation in various parts of the species' range. At the level of differentiation considered as of racial stature, wide ranging populations occupying the larger natural physiographic regions of western North America are recognizable. Examples are the pale buff population (*hesperis*) of the Great Basin and immediately adjacent areas where gray and light buff soils predominate, and the tawny population (*henryi*) of the deserts and mountains of the southwestern United States and northwestern México, where extensive areas of reddish soil occur. Within

each of the racial populations there is geographic variation of a lesser magnitude. Variation of this order, which has been described in the subspecies accounts, usually has the pattern of clinal changes in minor color characters.

Intrapopulation variability of pattern and color is correlated with the diversity of the ecological substrate. It is at a minimum in populations inhabiting regions of uniform soil color and vegetation type and it is greater in those which are distributed over a wide altitudinal range and consequently occupy several types of soil and vegetation. This relation is well illustrated within the range of the race *hesperis*, where the uniformity of birds from the Snake River Basin of southern Idaho contrasts with the greater variability of the populations of Nevada, California, and Utah. The first mentioned region is a flat semi-desert lying at about 4000 feet in elevation, where desert scrub, composed especially of sagebrush (*Artemisia*) and greasewood (*Sarcobatus*), is the dominant vegetation type. The soil is for the most part uniformly gray in color. Samples from this area show an unusual degree of uniformity of color and pattern. In Nevada this species occurs on the desert flats in the Upper Sonoran Zone and also extends upward in the numerous small mountain ranges into the boreal zones, thus occupying an altitudinal range from 4300 to 8600 feet, as indicated by data from specimens. This greater altitudinal range is associated with a greater degree of variability of characters as compared with the population of southern Idaho. In California records of summer occurrences are from 600 to 11,000 feet, although nesting seems confined to stands of coniferous trees in the upper part of this altitudinal range, largely in the Transition, Canadian, and Hudsonian zones, above about 4000 feet (Grinnell and Miller, 1944:210). The total range of variability of California birds is greater than that in Nevadan birds because of the common occurrence of dark individuals in various degrees approaching the northern race *minor*. Such extreme variants are uncommon in Nevadan samples and they are lacking in those from Idaho, but they regularly occur in populations of *hesperis* in western and central Montana and elsewhere in the Rocky Mountain region. In northeastern Utah the variational span of samples is equal to that of several of the racial types. In this region nighthawks have a vertical range of 5000 or more feet and encounter a variety of vegetation and soil types. Here they occur from the desert scrub flats at approximately 5000 feet in elevation upward through the piñon-juniper forest (about 5500 to 7000 feet), yellow pine forest (about 6000 to 8000 feet), and sagebrush stands (various elevations), sparingly to the Englemann spruce-alpine fir forest (to about 10,000 feet). Similarly great variation is seen in other populations inhabiting mountainous regions, notably those of central and western Colorado, Wyoming, and central southern Montana. In these regions, located as they are between areas of occurrence of several racial types, normal variability may be enhanced by gene flow from these adjacent differentiated populations.

In summary, the evidence would seem to indicate that in areas where nighthawks necessarily are restricted to one or a few habitats, selection acts to produce a correspondingly narrow range of variation, while more environmentally diverse regions are, in a sense, able to support a wider range of color and pattern types. Correlations between population and habitat variability also have been noted in *Pipilo fuscus* by Davis (1951:89) and in *Aphelocoma coerulescens* by Pitelka (1951:364).

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