VARIATION IN WESTERN SPARROW HAWKS

By RICHARD M. BOND

The problem of what to call the sparrow hawks of various parts of the southwestern United States and northwestern Mexico has long been a puzzling one. Names employed in the past are *Falco sparverius sparverius, F. s. phaloena, F. s. deserticolus* and *F. s. penninsularis*. Descriptions and ranges given by various authors (A.O.U. Check-list, 1910, 1931; Bergtold, 1927; Grinnell, 1914; van Rossem, 1931) have done violence to each other and have usually been of small assistance to the ornithologist who wishes to assign a name to a specimen with some assurance that it actually fits.

In an effort to shed some light on the problem, I have carefully examined and measured 678 sparrow hawks, chiefly from western North America. About 75 additional specimens were examined casually, but are not included in this study because they were too worn or too young, or were molting too heavily to be measured, or because the data were incomplete. In addition, I have used, in one section of this paper, wing measurements of 49 specimens from British Columbia (37 from the Provincial Museum, 12 from the collection of Mr. Kenneth Racey). These measurements were taken for me by Dr. I. McT. Cowan,to whom I offer my sincere thanks. The collections to which the specimens examined by me belong are shown in table 1. To all the owners and curators of these specimens I am extremely grateful for permission to study them and for other assistance. I am especially indebted to Dr. A. H. Miller of the Museum of Vertebrate Zoology in Berkeley and to A. J. van Rossem, Curator of the Dickey Collection in Los Angeles, not only for access to specimens in their care, but for many courtesies and much assistance.

Table 1

	Males	Females	Total
California Academy of Sciences	33	24	57
Donald R. Dickey Collection	56	34	90
Collection of Laurence M. Huey	4	7	11
Collection of Stanley G. Jewett	15	21	36
Museum of Comparative Zoology	39	48	87
Museum of Vertebrate Zoology	133	115	248
United States National Museum	46	34	80
Santa Barbara Museum of Natural History	11	6	17
San Diego Museum of Natural History	26	26	52
Totals	363	317	678

The exact localities at which specimens were collected are not included herewith, since the amount of space that would be needed seems out of proportion to the advantages that might accrue. Distribution by states, provinces, and countries is as follows: Alaska, 1; British Columbia, 22; Alberta, 2; Ontario, 1; Washington, 21; Oregon, 50; California, 234; Baja California (except Guadalupe Island), 142; Guadalupe Island, 13; Idaho, 8; Nevada, 22; Arizona, 72; Sonora, 34; Sinaloa, 1; Nayarit, 3; Guerrero, 13; Montana, 4; Wyoming, 1; Colorado, 5; New Mexico, 4; Kansas, 1; Texas, 3; Nuevo León, 1; Tamaulipas, 1; Puebla, 1; Vera Cruz, 1; Panama, 1; Minnesota, 3; Wisconsin, 2; Indiana, 1; Ohio, 1; Georgia (northern), 2; New York, 2; Connecticut, 2; New Jersey, 2; North Carolina, 1.

This number and distribution of specimens should give a fairly good picture of local variation in the species if there were any assurance that the birds were members of the breeding population where they were collected. Unfortunately, quite the opposite is true, since the majority were taken other than in the breeding season and may have

come from nearly anywhere to the north, or from some distance to the east, west or south. The months in which the specimens were collected are shown in table 2.

Table 2

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
67	35	52	50	**57**	**58**	**57**	52	66	63	51	69

Because sparrow hawks are at least partly migratory, many of these 678 specimens are of little value in a zoögeographical study. Only 8 males and 8 females were reported to be breeding by their collectors, and two of these notations are followed by a question mark. Since these hawks were taken from as far south as Guaymas, Sonora, and Bahia Dolores, Baja California, and as far north as Creston, British Columbia, they cover the ground too thinly to be of much value. I have, therefore, for this study, considered as "breeding" birds or locally hatched young the 172 specimens collected in May, June and July; these are shown in table 2 in bold type. Not quite all of these, however, can safely be used, since five are immature birds in worn plumage and may possibly be non-breeders far from where they were hatched. Although three males in the Dickey Collection (2 intergrades and one *penninsularis*) show that sparrow hawks may breed when less than one year old, and although I should not be surprised to find this to be the prevailing habit in the species, the low survival of immature birds, the incompleteness of collectors' field notes, and the difficulty of distinguishing immature birds that are badly worn, especially females, make it impossible to determine the extent of such breeding from the material examined. Accordingly it was thought best to exclude such specimens. There is also likely to be a small, but entirely undetectable percentage of non-breeding adults from foreign parts. One female, collected in Santa Barbara County, California, May 12, 1930, is so much larger than the other "breeding" birds of southern California that it seems almost certain to be a migrant or non-breeder; it has been eliminated from consideration. Since five of the birds marked as breeding by the collectors have March or April dates, however, the total number of specimens to work with was 171, as follows (some place names shortened or simplified):

Alberta: Fawcett, 1 ♂. Total, 1.

British Columbia: Alberni Valley, Vancouver Isl., 2 ♂ ♂, 1 ♀; Creston, 1 ♂, 1 ♀; Hazelton, 1 ♂, 2 ♀ ♀; Kispiox Valley, 2 ♂ ♂; Stikeen River, 1 ♀. Total, 11.

Arizona: Chiricahua Mts., 1 ♂; Fort Lowell, 1 ♂, 1 ♀; Fort Whipple, 2 ♂ ♂; Huachuca Mts., 1 ♀; Patagonia, Santa Cruz Co., 2 ♂ ♂; Prescott, 1 ♂; Sacaton, Pinal Co., 2 ♂ ♂, 1 ♀; Santa Cruz River, 1 ♂, 1 ♀; 20 mi. S Springerville, Apache Co., 1 ♂, 2 ♀ ♀; 28 mi. S Springerville, 1 ♂, 1 ♀; Tucumcacori, 1 ♂; Tucson, 1 ♂; 37 mi. S Tucson, 1 ♂; Verde, 1 ♂; Whiskey Creek, Tunitcha Mts., 2 ♀ ♀; White Mts., 1 ♂. Total, 26.

California: Bard, Imperial Co., 1 ♂; mouth of Battle Creek, Tehama Co., 1 ♂; Benton, Mono Co., 1 ♂, 1 ♀; Big Pine, 1 ♂, 1 ♀; Bridgeville, Humboldt Co., 1 ♀; Cima, San Bernardino Co., 1 ♂, 1 ♀; Dry Creek, Warner Mts., 1 ♂; Dudley, Mariposa Co., 1 ♀; Eagleville, 1 ♀; 12 mi. S Eagleville, 1 ♂; Gualala, Mendocino Co., 1 ♂; Happy Camp, Siskiyou Co., 1 ♂; Hesperia, San Bernardino Co., 1 ♂; Humphrey's Basin, Fresno Co., 1 ♂; Julian, San Diego Co., 1 ♀; Lake Tahoe, 1 ♀; McKessick Peak, Plumas Co., 1 ♀; Mono Lake, 1 ♂; Owl Creek, Warner Mts., 1 ♂; Palo Verde, Imperial Co., 1 ♀; Panoche, 1 ♂, 1 ♀; Red Rock P. O., Lassen Co., 1 ♀; Riverside, 1 ♂; Ruth, Trinity Co., 2 ♂ ♂; 12 mi. NW Ruth, 1 ♀; San Fernando, 1 ♂; San Francisquito Canyon, Los Angeles Co., 1 ♂; San Gabriel Mts., 1 ♂; San Jacinto Mts., 1 ♂, 1 ♀; San Luis Rey, 1 ♂, 1 ♀; Santa Barbara, 1 ♂; Squaw Creek, Warner Mts., 2 ♀ ♀; Susanville, 1 ♂; Trout Creek, Tulare Co., 1 ♂; Ventura, 2 ♀ ♀; Visalia, 1 ♀; Walker Pass, Kern Co., 1 ♂; White Mts., Mono Co., 3 ♂ ♂; White Mts., Inyo Co., 1 ♂. Total, 50.

Idaho: Coeur d'Alene, 1 ♂, 1 ♀; Twin Falls Co., 1 ♀. Total, 3.

Montana: Forsythe, Rosebud Co., 1 ♀; Missoula Co., 1 ♀; Powder River Co., 1 ♂; Rosebud Co., 1 ♂. Total, 4.

Oregon: Adel, Lake Co., 1 ♂; Anthony, Baker Co., 1 ♀; Dufur, Wasco Co., 1 ♀; La Grande, 2 ♂ ♂; Lakeview, 1 ♂; Portland, 2 ♂ ♂, 1 ♀; Prineville, 1 ♀; Swan Lake, Klamath Co., 1 ♂, 1 ♀; Wallowa Co., 1 ♀. Total, 13.

Nevada: Charleston Mts., 1 ♀ ; Dyer, Esmeralda Co., 1 ♂, 1 ♀ ; Jefferson, Nye Co., 1 ♀ ; Pine Forest Mts., 1 ♂ ; Pyramid Lake, 2 ♂ ♂ ; Head Reese River, Toyabe Mts., 1 ♂ ; Sharp, Nye Co., 1 ♂, 1 ♀ ; Smoky Creek, Washoe Co., 1 ♀ ; Truckee Valley, 1 ♀. Total, 12.

New Mexico: West side San Luis Mts., Hidalgo Co., 1 ♀. Total, 1.

Washington: Clallam Co., 1 ♂ ; Keechelus, Kittitas Co., 1 ♂ ; Tacoma, 1 ♂ ; Wahkiakum Co., 1 ♂. Total, 4.

Baja California: Because many of the place names used by collectors have gone out of use, or have been misspelled, or are duplicated in various parts of the state, the approximate latitude of each locality (usually correct to the nearest half degree) is given herewith. Agua Caliente (23° 30′), 1 ♂, 1 ♀ ; Cañon San Juan de Dios (30°), 1 ♀ ; Carmen Island (26°), 1 ♀ ; Dolores Bay (25°), 1 ♂ ; Ensenada (32°), 1 ♂, 1 ♀ ; 20 mi. E Ensenada, 1 ♀ ; Guadalupe Island (29°), 6 ♂ ♂, 7 ♀ ♀ ; La Grulla (31°), 1 ♂, 3 ♀ ♀ ; La Paz (24°), 1 ♀ ; Miraflores (23° 30′), 1 ♀ ; Nachogüero Valley (32° 30′), 1 ♂, 2 ♀ ♀ ; San José (31°), 1 ♀ ; San José del Rancho (24°), 1 ♂ ; San Ignacio (27° 30′), 1 ♂ ; San Quentín (30° 30′), 1 ♂ ; Santa Rosalía Bay (28° 30′), 1 ♀ ; 10 mi. S Santa Rosalía (27°), 2 ♂ ♂ ; 40 mi. W Santa Rosalía (27° 30′), 1 ♂ ; Santo Tomás (31° 30′), 1 ♂ ; San Ysidro Ranch (32° 30′), 1 ♀ ; Tecate Valley (32° 30′), 1 ♂, 1 ♀ ; Triunfo (24°), 1 ♂. Total, 43.

Sonora: Guaymas, 1 ♂, 2 ♀ ♀. Total, 3.

This would be a better sample if it were more evenly distributed, but seemingly much collecting is done when the weather is nice. Hence collecting in the north (where the problem is less difficult) has been done in the summer, and in Mexico and the southwestern United States mainly in the winter. Thus, although I have examined 55 specimens from continental Mexico (exclusive of Baja California) only three (those from Guaymas, Sonora) are breeding birds.

Color and pattern.—These features were closely observed in all the specimens examined, and Mearns' remarks (1892) upon their extreme variability were abundantly confirmed. Such conclusions as could be drawn will be given later, except for the following major generalization: The individual variation is so great and so complicated by fading and wear, and overlap of characters of populations from various regions is so complete and the means so close, that with the exception of the birds from Guadalupe Island, Baja California, color and pattern are of no value in distinguishing western races of sparrow hawks.

Dimensions.—Measurements taken of the specimens were: wing length, tail length, chord of culmen (including cere), depth of upper mandible at anterior margin of cere, length of tarsus, and length of middle toe without claw. These measurements are of very different value.

Wing length.—This measurement is probably the most reliable. I have used extreme length, rather than chord, because the way the skins are made up and the slight curvature of the feathers makes this method of measuring easier in this species, and the results are more strictly comparable as between specimens. The skins were classified by eye into four stages of wear, such that I judged the most worn group to have lost about 2 mm. of wing length; specimens more worn than that were not used. Skins collected at all seasons from British Columbia, Washington, Oregon, and northern California (a reasonably homogeneous group) were compared statistically by wear groups, and the groups were not found to differ significantly. However, because actual wear could be seen, the measurements found for the most worn specimens have been extended by 1 mm. in the records and calculations. This has the effect of still further reducing an already insignificant difference.

Tail length.—This measurement is much less reliable than wing length for two reasons. Wear is much greater and more irregular, occurring, for example in young in the nest before the feathers are fully grown in. Adults in the nesting season, that are otherwise in fair condition, often show extreme tail wear, perhaps from incubating in a small cavity. At any rate, the tails of only about half the specimens show little enough

wear to be worth measuring. Also, it is usual for collectors to cut across the tail when preparing specimens, and this cut is often made to include the basal ends of the quills. This practice appears to result in a considerable difference in the amount of shrinking of soft tissues in different skins, with a consequent difference in the amount of quill exposed. The only reason that the measurement was taken with such care is that Mearns (1892) used it in his diagnosis of *F. s. deserticolus*. There is a significant positive correlation between wing and tail lengths, but the tail lengths are more variable than the wing lengths.

Beak.—In the hawks, especially in the falcons, adequate measurements of the bill are practically impossible to take, largely because slight differences in wear in bills of this shape make for relatively great differences in the measurements and also because of the difficulty in locating accurately the basal point of the culmen. Mearns apparently excluded the cere in this measurement, but there is considerable difference in the shrinkage of that structure and hence, in some skins, of the amount of culmen exposed.

Tarsus and middle toe.—The accuracy of the measurement of the tarsus depends partly on the make of the skin, and that of the middle toe can only be taken if the toe is straight. How straight is "straight" depends all too much on how the measurer happens to decide at the moment.

Weights.—Ninety-three of the specimens were weighed by their collectors, but only 28 of the "breeding" birds were weighed. Because falcons weigh less, as a rule, in the summer during the breeding and molting seasons, and because a sparrow hawk can, and sometimes does, cram into its crop and stomach nearly 50 gm. of food at a meal, only weights taken at the same season and with the gut emptied before weighing would be strictly comparable. A captive female I had weighed 130 gm. empty and 179 gm. after a gorge. About all that these weights show is that birds with long wings averaged heavier. This was determined by plotting weights against wing lengths. The regression coefficients were not calculated.

There is considerable sexual difference in the size of sparrow hawks; accordingly the sexes must be considered separately. It was feared that there might be a significant difference between immature and adult birds of the same sex. (I use the term "immature" to mean a bird of the year in which feather growth has been completed, and "juvenile" to indicate a bird in which remiges and rectrices are still growing.) Statistical analysis of specimens from the same area used in checking on the wear groups showed this not to be the case. This is fortunate because many of the specimens cannot be assigned to either age group with any degree of certainty. This difficulty is most marked in birds from southern Baja California, where in some cases only the stage of growth of the feathers serves to distinguish juveniles from adults.

References on statistical methods.—In applying the methods and formulae of statistical analysis to this study, the texts of Bruce and Schumacher (1935), Fisher (1935), Snedecor (1937), and Simpson and Roe (1939) were used. The reader, if unfamiliar with the terminology, may refer to one of these standard sources.

Falco sparverius sparverius

Synonyms: F. s. phaloena (Lesson) (1845, col. 1087). The possibility of ever determining what Lesson had in hand seems hopeless. The description is clearly of some subspecies of sparrow hawk, but subspecific characters are lacking. The total length (24 cm.) is the only measurement given. Only the male is described. Where and when the type specimen was taken are not stated. If it came from San Blas ("San-Blases" according to Lesson), it might conceivably be *penninsularis*, although it is not known at present how far south of Sonora this race occurs. There are two towns of that name on the Mexican coast between Sonora and Acapulco. The second locality mentioned, Acapulco, is outside the breeding range of sparrow hawks, so that if the type was collected there, it must have been a wintering *F. s. sparverius*. Even if it should be discovered that sparrow hawks breed at either

of the towns of San Blas, without the date, type specimen or a more exact description, it would be impossible to guess whether the name was applied to the local race or to the migrant one. A. J. van Rossem informs me that so far as he has been able to discover, Lesson's type no longer exists; accordingly, the status of the name *phaloena* must be indeterminable, probably a synonyn of *sparverius*.

F. s. deserticolus Mearns (1892:263). This is clearly a synonym of *F. s. sparverius*. See discussion beyond and in section on intergrades.

Variations in size.—From the study of specimens and their measurements, it eventually became clear that the birds of Alaska, British Columbia, Washington, Oregon, Idaho, at least the northern two-thirds of Nevada, California west of the Mojave and Colorado deserts, and Baja California west of the Sierra Juárez and Sierra San Pedro Martír and south on the Pacific coast to about lat. 30° 30′ N. were a generally homogeneous group. The measurements of the specimens from this area are shown in table 3.

Table 3

Falco sparverius sparverius from western North America

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation*	Coefficient of variation
Wing length ♂ ♂	54	181-200	187.79 ± .57	4.24 ± .44	2.26 ± .22
Wing length ♀ ♀	44	188-206	196.43 ± .73	4.87 ± .52	2.48 ± .26
Tail length ♂ ♂	7	116-125	119.38	....	....
Tail length ♀ ♀	7	116-131	122.14	....	....
Chord of culmen ♂ ♂	45	13.1-15.7	13.94 ± .09	.57 ± .06	4.08 ± .43
Chord of culmen ♀ ♀	37	13.0-15.3	14.47 ± .10	.60 ± .07	4.17 ± .49
Depth of upper mandible ♂ ♂	45	5.6-7.5	6.46 ± .06	.37 ± .04	5.75 ± .61
Depth of upper mandible ♀ ♀	38	5.9-7.4	6.58 ± .06	.38 ± .04	5.84 ± .67
Tarsus ♂ ♂ and ♀ ♀	45 ♂ ♂ + 43 ♀ ♀	38-44	41.11 ± .15	1.37 ± .10	3.33 ± .25
Middle toe ♂ ♂ and ♀ ♀	20 ♂ ♂ + 26 ♀ ♀	21-26	23.78 ± .15	1.04 ± .11	4.36 ± .46

*Standard deviation and standard error are used throughout. The formula $\sigma = \sqrt{\frac{\Sigma d^2}{N-}}$ for the standard deviation was used in all cases. All significant decimals were used in calculation, but the figures are rounded to two places in the tables.

The wing measurements and the statistical constants derived from them mean that about 68 per cent of the males have wing lengths between 183.55 and 192.03 mm., and that over 95 per cent fall between 179.31 and 196.27. Corresponding figures for the 44 females are: $M \pm \sigma = 191.56–201.30$ and $M \pm 2\sigma = 186.69–206.17$. It will be seen that the females are not only larger than the males, but are more variable as well.

The tail lengths given in the table are too few and too variable to mean anything. However, 66 fresh fall and winter males from the same area (some doubtless migrants from the north) were measured with the following results: $M = 120.02$, $\sigma = 5.15$, $V = 4.29$. The correlation coefficient between wing length and tail length of these specimens was $r = .55$, which is significant (that is, a bird with long wings is likely to have a long tail). The regression coefficient of tail length on wing length was .48, from which it can be shown that the tail length of the "average sparrow hawk" for this group can be found by the equation:

$$\text{Tail length} = 29.68 + .48 \text{ (wing length)}.$$

The relative length of the tail (as compared to the wing) in males does not differ significantly from that of the females, nor from what is found in the other races.

There is no significant difference in the length of tarsus or length of middle toe as between subspecies, areas, or sexes in the region treated here. A few specimens of *F. s. paulus* that were measured out of curiosity in the course of this work seemed to have smaller feet than the western birds.

With respect to wing length, the 54 "breeding" males from the area outlined above were compared statistically with the 22 males available to me from the eastern United States and Canada (excluding those from Florida and southern Georgia). The measure-

ments of these latter were: $M = 186.32 \pm 1.10$; $\sigma = 5.18 \pm .78$; $V = 2.78 \pm .42$. The difference of the means is only 1.47 mm., and this divided by its standard error is only 1.29, which is far from significant. In other words, there is no indication that the eastern and western samples did not come from the same homogeneous population. I had available only six eastern females which also do not differ significantly from those

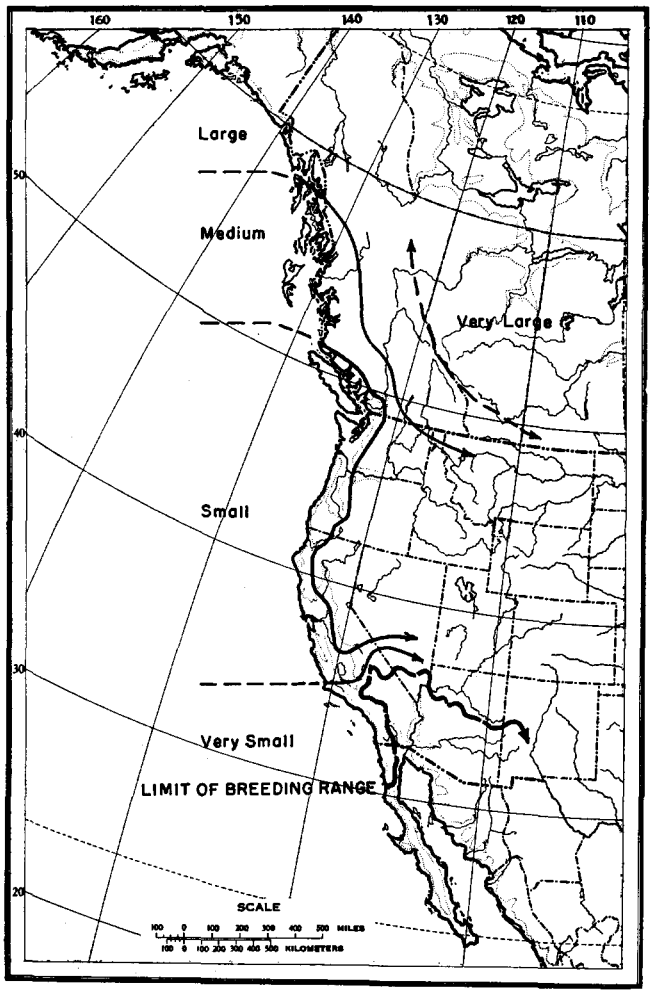

Fig. 46. Size variation in *Falco sparverius sparverius*. Positions of lines are approximate (see text).

of the west. Since I cannot see any other difference between the eastern and western sparrow hawks, I conclude that the current allocation of birds from California and northward to *F. s. sparverius* is entirely correct.

The boundaries of this western area of homogeneity were arrived at by separate examination of breeding specimens from various sub-areas, such as the Northwest Coast, Columbian Plateau, Great Basin, Sacramento-San Joaquin Valley, and Southern Coastal California, and it at first appeared that specimens from the north averaged larger than those from the south. The cline of average wing length, however, does not

bear a simple relation to latitude except in the southern half of California, where the correlation is striking. It seems impossible with the specimens available to describe the situation in mathematical terms. A rough approximation of the size variation is given on the map (fig. 46) where distribution of size groups is shown. It should be clearly understood that study of more and better distributed specimens might lead to considerable shifting of the lines on the map, and that I have not meant to indicate that the difference between the "very small" and "small" birds is the same number of millimeters (or the same fraction of σ) as between any other two adjacent groups shown.

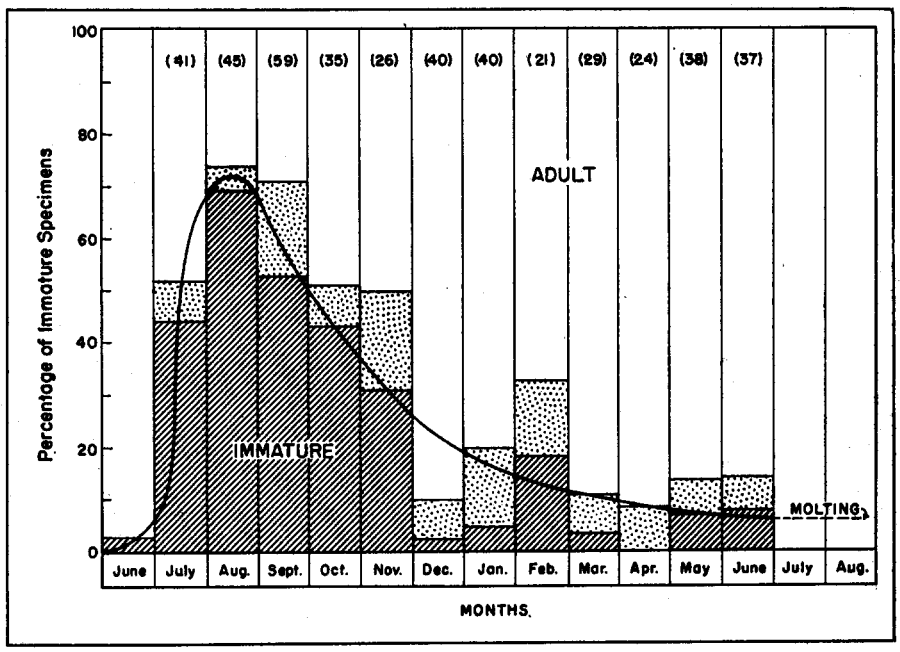

Fig. 47. Percentage of immature *F. s. sparverius* in total population by months. Left-hand June column shows birds fledged in current season; at right, June survivors from previous year. Dotted areas indicate birds of doubtful age, the majority of which are probably immatures. Figures in parentheses indicate number of specimens.

It appears that the line between "medium" and "large" sparrow hawks approximates the line separating the regular migrants, to the northeast, from those partly or completely non-migratory, to the southwest. And it might seem that these differences in size and migratory habits would be a suitable basis for separating another subspecies, comparable to the separation of *Zonotrichia leucophrys pugetensis* from *Z. l. nuttallii*. This I think is emphatically not the case. In the first place, the size difference of the sparrow hawks is one of *means*. The individual size variation is enormous, and overlap is complete or practically so. In the second place, migration in sparrow hawks is no such regular matter as in the sparrows and the line between migrants and non-migrants this year is probably a very poor guide to where it will be next year when food supply and weather may be quite different.

Plumages.—I can see no evidence that any fall molt of the young takes place. All changes in appearance are attributed to wear and fading. Immature specimens are not always certainly distinguishable even in fresh plumage; the most useful criteria of immaturity are: (a) heavier spotting on the underparts, the spots being longer and occurring higher on the breast; (b) breast feathers of downier consistency (before be-

coming worn); (c) heavier barring on the back; (d) wider and paler tips of the primaries (before excessive wear). A useful, though less reliable, criterion is the presence of dark shaft streaks in the crown patch. Immature females are much more difficult to distinguish than immature males.

Longevity.—First-year birds disappear rapidly after reaching a peak of about two-thirds of the population in August. This is shown in figure 47. Specimens taken in spring are too few and the immatures too difficult to distinguish in worn plumage for the figures to be conclusive, but it appears that about 11 to 17 per cent of the young produced reach adulthood. The average life expectancy of sparrow hawks one year old is about 8.3 to 12.5 more years.

Migration.—Comparison of specimens taken at various times of the year in some areas shows clearly the fact of migration. Specimens from the area comprising all of Arizona and the California counties of Santa Barbara, Ventura, Los Angeles, San Bernardino and those to the south were grouped by months. There were not enough specimens taken in several of the months to give reliable results, and the variations in parts of the area in which the birds were collected makes the figures still less reliable. However, by averaging the wing lengths by seasons, these difficulties were largely obviated. The results (fig. 48) for the 120 males were (numbers in parentheses are numbers averaged): summer (May, June, July and August) (33), 184.18; fall (September through December) (44), 188.02; winter (January and February) (25), 183.60; spring (March and April) (18), 187.56. For the 67 females the results were: summer (15), 189.33; fall (25), 194.56; winter (12), 193.42; spring (15), 194.67. My interpretation of this is that the resident breeding population is greatly augmented in the fall by larger migrants from the north, many of which, however, have left the area and gone still farther south by late winter. In March and April the surviving migrants have returned on their way north, and by May practically all have left the area. The chart makes it appear that the females and males have somewhat different migrational habits. Actually this evidence is spurious and mainly a result of the small size of the samples and partly of the geographical distribution of the individual specimens. There were not enough specimens for all months from either the southern part of the range of *sparverius* or from southern Arizona to make use of a more homogeneous breeding area, but I have no doubt that the general effect would be the same. (Note: a similar migration curve is shown by Allan and Sime (Wilson Bull., 55, 1943:29-39).)

According to Bent (1938), the species breeds as far north as Alaska and Mackenzie but does not winter north of southern British Columbia. In British Columbia, Washington, Idaho, Oregon, northern California, and northern Nevada, and even farther south, there is a noticeable migratory movement in fall and early winter. In southern California there is a marked increase in numbers of sparrow hawks at this season that is obviously caused by an influx of wintering and migrant birds from the north, and I have observed the same phenomenon in Arizona and Sonora.

Generally speaking, species of western birds that have been intensively studied show a tendency for the northernmost populations to migrate farthest south in winter (Swarth, 1920; Blanchard, 1941; Miller, 1941) passing over the southern and less migratory, or resident populations. Although there are exceptions to this rule, it may be at least a fair guess as to what sparrow hawks do.

It thus appears likely that *F. s. deserticolus* of Mearns and many birds marked "*F. s. phaloena*" in collections are in truth only migrants from Canada. Because of the faded condition of a large proportion of the large immature specimens taken in Arizona and Sonora in fall and early winter, I suggest the possibility that they were hatched perhaps as far inland as the area east of the Rockies, where insolation is greater than

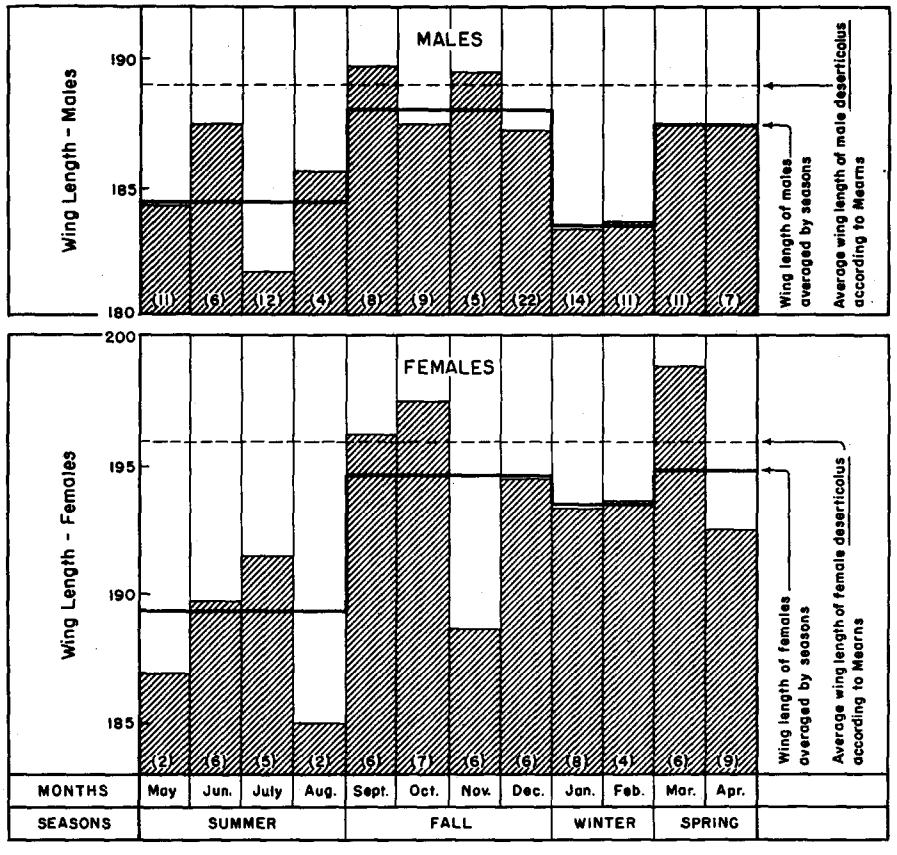

Fig. 48. Average wing lengths of sparrow hawks from Arizona and southern California. Shaded columns, averages by months; heavy line, averages by "season." Numbers in parentheses indicate numbers of specimens.

in most of the area to the westward. Faded adult specimens taken in Arizona and Sonora from January through May, of course, may have faded in their winter habitat.

Falco sparverius penninsularis

Nine males and eight females clearly assignable to this race have been examined. These were collected in May, June or July in Baja California at points from Cañon San Juan de Dios (about lat. 30° 05′ N.) south to the Cape District and from Isla Carmen in the Gulf of California. Three breeding specimens from Guaymas, Sonora, also fall well within the size range of this subspecies. On the basis of this and other evidence to be discussed beyond, I believe that the breeding range of *penninsularis* is approximately as follows: Coastal (within about 50 km. of the Gulf) and southern (south of Guaymas) Sonora, and all of Baja California south of latitude 30° 05′ N., and the area north of that line that lies east of the Sierra Juárez and the Sierra San Pedro Martír (see map, fig. 49). For convenience, part of the north boundary of the range is taken as the United States-Mexico line, which it must in fact very closely approximate.

South of 30° 05′ N., on the basis of the sample available to me, no cline of any sort could be distinguished, and the population appears to be perfectly uniform, or perhaps it would be better to say equally variable everywhere.

The measurements of these 17 specimens, and their statistical functions, are shown in table 4. It will be observed, as regards wing length, that M + 2σ of *penninsularis* (males 178.04, females 186.77) is less for males than M — 2σ of *sparverius* (males 179.31, females 186.69), and that the figures barely overlap for females. Thus, theoretically, less than three per cent of the males and less than six per cent of the females of each subspecies overlap the other and are indistinguishable. That is, if 100 male specimens of *sparverius* were mixed with 100 of *penninsulars*, 197 or more could be separated and correctly named on the basis of wing measurements, and only 1.5 per cent or less (3 per cent or less of females) of the birds would be unassignable.

Table 4

Falco sparverius penninsularis

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation	Coefficient of variation
Wing length ♂ ♂	9	164-175	169.22 ± 1.47	4.41 ± 1.04	2.61 ± .62
Wing length ♀ ♀	8	166-182	175.75 ± 1.95	5.51 ± 1.38	3.14 ± .78
Tail length ♂ ♂	1		114	....	....
Tail length ♀ ♀	3	102-113	107.67	....	....
Chord of culmen ♂ ♂	7	13.6-15.0	14.43 ± .19	.51 ± .14	3.51 ± .94
Chord of culmen ♀ ♀	7	13.2-16.2	14.46 ± .38	1.01 ± .27	7.00 ± 1.87
Depth of upper mandible ♂ ♂	7	6.3-7.0	6.70 ± .11	.30 ± .08	4.40 ± 1.18
Depth of upper mandible ♀ ♀	6	6.3-7.1	6.70 ± .12	.30 ± .09	4.53 ± 1.31
Tarsus ♂ ♂ and ♀ ♀	9♂ ♂ + 7♀ ♀	38-43	40.31 ± .37	1.50 ± .27	3.71 ± .66
Middle toe ♂ ♂ and ♀ ♀	2♂ ♂ + 5♀ ♀	22-26	23.86 ± .48	1.26 ± .33	5.30 ± 1.42

Among the 315 sparrow hawks from within the western part of the breeding range of *F. s. sparverius*, 10 or 3.15 per cent are smaller than M + 2σ of *penninsularis*. (One of the 10, from northwestern Baja California, may actually be an example of *penninsularis* that wandered 75 or 80 miles out of its breeding range.) These figures compare very well with the < 3 per cent for males and < 6 per cent for females expected from statistical theory.

Fifteen fresh males (all seasons) from Baja California had a correlation coefficient between wing length and tail length of r = .72; regression of tail length on wing length of .886, giving the formula:

$$\text{Tail length} = .886\ (\text{wing length}) - 42.06$$

This, compared with *sparverius* seems to show that *penninsularis* is relatively as well as actually shorter tailed, but the difference between the regression coefficients divided by the standard error of the difference is only 1.14, which is far from significant.

The collecting localities of males and females with wing length equal to or less than the mean of *penninsularis*, between M and M + σ, and between M + σ and M + 2σ were plotted on a map (not reproduced because of its undue complexity), and it is on the basis of this map in addition to evidence from the breeding specimens from Guaymas, Sonora, and those from Baja California that the breeding range of *penninsularis*, as given above, was worked out. It would appear to be relatively safe to assign any male sparrow hawk with a wing length of 178 mm. or less, taken in the indicated breeding range at any time of year, and any female similarly taken, with a wing length of 186 mm. or less, to *F. s. penninsularis*.

Some specimens of this race can be identified as immature by the same criteria which apply to *F. s. sparverius*, but the differences between immature and adult specimens of *penninsularis* are much less well marked on the average. The fluffy texture of the breast feathers of immature birds seems to be the most reliable criterion for specimens in fresh plumage, but it is not of much use except in fall and late summer. About

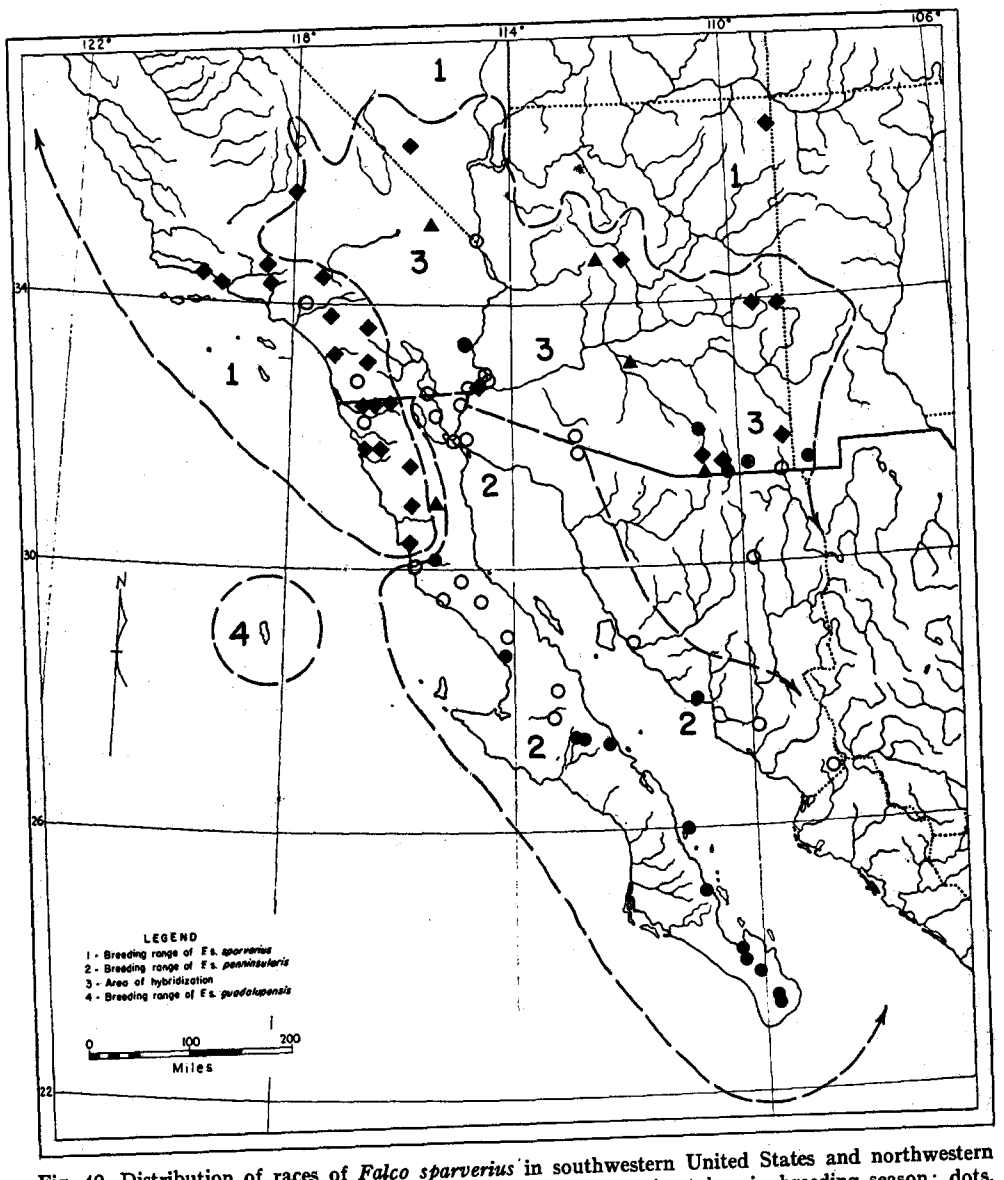

Fig. 49. Distribution of races of *Falco sparverius* in southwestern United States and northwestern Mexico. Diamonds, specimens in size range of *F. s. sparverius* taken in breeding season; dots, specimens in size range of *peninsularis* taken in breeding season; triangles, specimens in size range of both *F. s. sparverius* and *peninsularis* taken in breeding season; circles, specimens in size range of *peninsularis* taken other than in breeding season.

half the birds which were not yet fully fledged (not listed above) could have passed as adults had they been collected a few months later than they were.

There appears to be no consistent color difference between *F. s. sparverius* and *F. s. peninsularis*. Plumage of juveniles and fresh-plumaged immature specimens and the newly grown feathers of molting adults of *peninsularis* appear to average just as dark and just as red as in *sparverius*. So far as I can see, the usual paleness of specimens of

the southern race is entirely due to rapid and extreme fading. There are, however, average pattern differences, in that *penninsularis* has a smaller crown patch, less heavy barring on the back, less extensive spotting beneath, but not, as was reported by Mearns (1892), less complete dark barring of the webs of the primaries. There is complete overlap of these characters, however, and the average differences are too slight to be of value in assigning individual specimens to races. The "yellow iris" reported for this race by Mearns on the basis of Xantus' notes has not been seen since by collectors I have interviewed (A. J. van Rossem, Laurence Huey), nor has it been recorded in the field notes of other collectors to which I have had access (J. Grinnell, Chester Lamb), or on specimen labels I have seen. Probably Xantus was careless either in his observation or in writing his notes or labels.

As is the case with so many other birds, I suppose that there may be some post-breeding wandering of *F. s. penninsularis* to points outside the actual breeding range, but I would expect such movement to be relatively small. I know of no evidence to suggest that the subspecies is migratory in the slightest degree.

GUADALUPE ISLAND

The sparrow hawks of Guadalupe Island have long been known as *Falco sparverius phaloena* (= *deserticolus*) (see Thayer and Bangs, 1908; Grinnell, 1928) and quite reasonably so, since they fulfill Mearns' (1892) description remarkably well, by being large and pale (actually, in large part, faded). Since, however, *deserticolus* is a synonym of *sparverius* and the name *phaloena* is not assignable certainly to any subspecies, it has seemed desirable to re-examine this isolated population. On the bases of size, color, and insularity, I conclude that the Guadalupe Island birds should be separated from other named races, and I propose to call them

Falco sparverius guadalupensis, new subspecies
Guadalupe Island Sparrow Hawk

Type.—Adult male, no. 306169 Museum of Comparative Zoology; Guadalupe Island, Baja California, Mexico, June 10, 1906; collected by W. W. Brown.

Subspecific characters.—Size large, equal to *sparverius* from central British Columbia; appreciably larger than *sparverius* in northwestern Baja California and the southern half of California; much larger than *penninsularis*. The light collar in both sexes is relatively lighter than in *sparverius* or *penninsularis*; this appears to be more consistently true of the adults than of the immature specimens. The beak is relatively small.

I have been able to examine only 13 fully grown specimens of this race. These are five worn adult males, one immature male, one worn adult female, and six immature females. There is in addition a juvenal female on which the color of the collar could be examined. Since I have seen no fresh adults of either sex, I cannot give specific colors that are of any diagnostic value. However, it is possible to separate sparrow hawks, with reasonable success, into about five categories depending on the relative depth of color of the collar, compared to the ground colors of the breast and back. These classes are as follows (see fig. 50):

Class 1. Sections 1, 2 and 3 of collar as pale as ground color of breast.

Class 2. Section 1 as pale as ground color of breast; sections 2 and 3 distinctly paler than ground color of back.

Class 3. Section 2 of collar about as dark as ground color of back; sections 1 and 3 distinctly paler.

Class 4. Sections 2 and 3 about as dark as ground color of back; section 1 distinctly paler.

Class 5. Sections 1, 2 and 3 of collar about as dark as ground color of back.

On this basis, comparisons of the adults of *guadalupensis* with the neighboring populations are shown in table 5, the class numbers being treated as though they were measurements.

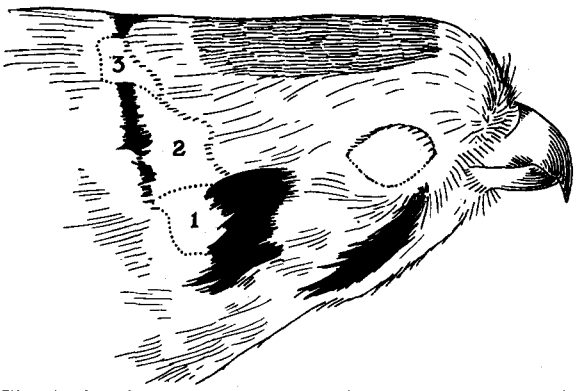

Fig. 50. Head of a sparrow hawk showing sections of collar referred to in text and in table 5.

Table 5

Comparison of collar color of *F. s. guadalupensis* with other populations of sparrow hawks

Measurement	Number	Mean	Standard deviation	Coefficient of variation
1. Worn adult *guadalupensis*	6	1.50 ± .35	.87 ± .25	57.73 ± 16.67
2. Worn adult *penninsularis*	29	3.66 ± .22	1.18 ± .16	32.29 ± 4.24
3. Worn adult *sparverius* from SW California and NW Baja California	25	3.88 ± .16	.80 ± .11	20.67 ± 2.92
4. Worn adult topotypes of "*deserticolus*" (Arizona and SE California)	16	3.50 ± .28	1.10 ± .20	31.51 ± 5.57

Difference of means of 1 and 2 divided by standard error of the difference = 4.25
Difference of means of 1 and 2 divided by standard error of the difference = 6.40
Difference of means of 1 and 2 divided by standard error of the difference = 4.00

Although classification into groups by collar color is rather subjective, I think that the differences of the means of the adults are significant. In the fresh immatures, the differences are less well marked, although *guadalupensis* has the palest collar (mean = 2.50). The seven immature *penninsularis* averaged 2.57, which is not significantly different, and the 10 *sparverius* from the opposite mainland had a mean of 3.20. This last may be significantly different. There were not enough fresh, immature topotypes of "*deserticolus*" to make a comparison.

The nearest point of the mainland of Baja California is almost exactly 135 miles from Guadalupe Island in a direction slightly north of east. The San Benito Islands are slightly farther south of east. San Clemente Island off California is about 240 miles due north. A sparrow hawk over the mainland shore would have to be over 4000 feet in the air under ideal atmospheric conditions even to see Guadalupe Island. Although this distance is easily within the powers of flight of a sparrow hawk, it seems to me most improbable that northern sparrow hawks regularly find the island from the mainland and winter there, or that birds from the adjacent mainland regularly visit it. On the other hand, the large size of the endemic race makes it seem possible that it was originally colonized by large, migrant birds from far to the north rather than by smaller, non-migratory individuals from the adjacent mainland.

The measurements of the birds from Guadalupe Island are given in table 6. The greater apparent variability of the males as shown by σ and V of the wing lengths is probably caused by the presence of one small (wing length = 180 mm.) individual in this small series. The usefulness of all the measurements for such small samples as are here shown is limited, but there is no question that *guadalupensis* is a large subspecies.

Although it is not very different in wing length from the mean of western *F. s. sparverius*, it is considerably larger than the *sparverius* from the nearest part of the range of the latter, which is the area marked "very small" on the map (fig. 46). Seventeen "very small" male *sparverius* have a mean wing length of 185.94 mm., or 3.39 less than in *guadalupensis*; the mean of 10 "very small" females is 194.50, or 2.21 less than in *guadalupensis*.

Table 6

Falco sparverius guadalupensis

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation	Coefficient of variation
Wing length ♂ ♂	6	180-196	189.33 ± 2.67	6.63 ± 1.91	3.50 ± 1.07
Wing length ♀ ♀	7	193-202	196.71 ± 1.36	3.61 ± .94	1.84 ± .49
Tail length ♂ ♂	1	121	121	....	....
Tail length ♀ ♀	5	116-129	120.6	....	....
Chord of culmen ♂ ♂	5	13.3-14.3	13.74 ± .19	.42 ± .19	3.03 ± .96
Chord of culmen ♀ ♀	7	13.3-14.9	14.33 ± .19	.51 ± .14	3.58 ± .96
Depth of upper mandible ♂ ♂	5	5.8-6.6	6.20 ± .17	.38 ± .12	6.14 ± 1.94
Depth of upper mandible ♀ ♀	7	5.9-6.6	6.17 ± .09	.23 ± .06	3.73 ± 1.00
Tarsus ♂ ♂ and ♀ ♀	5♂ ♂ + 7♀ ♀	40-44	41.58 ± .44	1.52 ± .31	3.64 ± .74
Middle toe ♂ ♂ and ♀ ♀	4♂ ♂ + 5♀ ♀	23-26	24.11 ± .26	.78 ± .11	3.25 ± .77

INTERGRADES

In an area comprising the Colorado and Mojave deserts, the whole watershed of the Gila River and its tributaries (at least as far east as the New Mexico line), and south at least to the Mexican boundary, the breeding sparrow hawk population is extremely variable. Southern Nevada probably should be included also, but I have seen but one summer-taken specimen from there. In this area there occur individuals of sizes typical of both *sparverius* and *penninsularis* as well as many birds close to the range of overlap of the two subspecies (see map, fig. 49). This is apparently a real area of general mixing, and not a case of either overlapping of ranges of two races that do not interbreed readily, nor interdigitation of ranges of the parent races involved. Nor are the birds typical of the normal intergrades developed in areas between two adjacent subspecies. The situation seems more nearly to represent the sort of "hybridizing," or secondary intergradation, to be expected from the interbreeding of fully differentiated parental races (see Miller, 1941, for analagous conditions in the genus *Junco*). The east slope of the Sierra Juárez and the Sierra San Pedro Martír in Baja California, and much of the State of Sonora should probably be included in this area of intergradation, although available material does not serve to make this certain.

Although additional collecting may make it possible to assign parts of the intergrading area to the breeding range of one subspecies or the other, it is clear that this area is both large and real and that any attempt to draw a geographic line across it and to assign specimens breeding on one side to one race and on the other side to the other race would do violence to the biological facts. Equally misleading and fallacious would be the attempt to establish a "size line" for the purpose of placing larger individuals in *sparverius* and the smaller individuals in *penninsularis*.

An interpretation of the distribution of the subspecies that suggests itself is that the ancestors of *penninsularis* were at one time completely isolated in the Cape Region of Baja California, which was then an island, and there became differentiated. Thus Mearns' characterization of *penninsularis* as an "insular race" was probably correct. Upon the rising of the central part of the present peninsula and the development of suitable environmental conditions, the population extended northward to meet the southern edge of the established range of *sparverius*. Coastal Sonora was unoccupied

by sparrow hawks until it was invaded from across the Gulf by *penninsularis*. Farther north, however, and perhaps inland, a scattered population of *sparverius* was already in residence. This population was perhaps newly arrived, or more probably was either physiologically not well suited to local conditions or for some other reason did not offer much competition to the invading *penninsularis*. The latter was thus able to extend well into *sparverius* territory. Since the races were well differentiated, but still able to interbreed freely, the secondary type of intergradation now found was produced.

Measurements of the "breeding" specimens from the area of intergradation are given in table 7. The apparent lesser variability of the females is probably due to chance rather than to an actual difference.

Table 7

Intergrades between *F. s. sparverius* and *F. s. penninsularis*

Measurement	Number of specimens	Observed limits	Arithmetic mean	Standard deviation	Coefficient of variation
Wing length ♂ ♂	19	164-192	182.37 ± 1.86	8.13 ± 1.32	4.46 ± .72
Wing length ♀ ♀	13	176-195	187.62 ± 1.52	5.47 ± 1.07	2.92 ± .57
Tail length ♂ ♂	3	112-114	112.67	....	....
Tail length ♀ ♀	5	110-120	116.60	....	....
Chord of culmen ♂ ♂	14	13.4-15.2	14.09 ± .13	.50 ± .10	3.56 ± .67
Chord of culmen ♀ ♀	13	13.9-15.7	14.62 ± .16	.59 ± .12	4.06 ± .80
Depth of upper mandible ♂ ♂	15	5.6-7.5	6.57 ± .13	.52 ± .10	7.89 ± 1.44
Depth of upper mandible ♀ ♀	12	6.0-7.8	6.79 ± .15	.50 ± .10	7.40 ± 1.51
Tarsus ♂ ♂ and ♀ ♀	19♂ ♂ + 13♀ ♀	36-43	40.66 ± .26	1.46 ± .18	3.58 ± .45
Middle toe ♂ ♂ and ♀ ♀	8♂ ♂ + 8♀ ♀	23-26	24.31 ± .22	.88 ± .16	3.61 ± .64

Migrant specimens of *sparverius* are abundant in the area of intergradation, and assignment of subspecific names to specimens collected there in March, April, September, October, November and December (and perhaps in January and February) presents a difficult problem. Since the migrants are probably mostly birds from far to the north, averaging large in size, it should be reasonably safe to class as intergrades any male with a wing length of 178 mm. or less, or any female of 186 mm. or less. A hypothetical collection of equal numbers of resident, intergrade males, and migrant, *sparverius* males, would theoretically have 16.5 per cent of the total distinguishable by wing length (less than 179 mm.) as intergrades. About 30 per cent of the total collection would have a wing length of 190 mm. or greater, of which about four-fifths would be of migrant *sparverius*. Perhaps the safest way to label specimens taken in the area of intergradation in fall, winter and spring would be to label males with wing length of 178 or less and females of 186 or less as "*F. s. sparverius* x *penninsularis*"; males from 179 to 186, and females from 187 to 194 as "*F. s. sparverius* x *penninsularis*?" and males 187 or more and females 194 or more as "*F. s. sparverius*?"

The "hybrid" type of interbreeding and slight degree of overlap of *sparverius* with *penninsularis* might seem reasons for elevating the latter to the rank of a full species. This, I think, would be a mistake. *F. s. penninsularis* is so obviously and so recently derived from *F. sparverius* that nothing would be gained and much would be lost by the separation.

STATISTICAL SIGNIFICANCE

Statistical comparisons of wing length and beak measurements of the races treated are shown in table 8. It will be noted that the comparisons of wing length show a clearly significant difference ($P = < .01$) in both sexes between *sparverius* and *penninsularis, guadalupensis* and *penninsularis*, and between both *sparverius* and *penninsularis* and the intergrade population between them. The differences between the beak measure-

Table 8

Statistical comparison of means of measurements of populations of sparrow hawks

	Mean wing length	Mean chord of culmen	Mean depth of upper mandible		Mean wing length	Mean chord of culmen	Mean depth of upper mandible
Male western *sparverius*	187.79 A	13.94 F	6.46 J	Female western *sparverius*	196.43 N	14.47 R	6.58 V
Male eastern *sparverius*	186.32 B	.....	.....	Female *guadalupensis*	196.71 O	14.33 S	6.17 W
Male *guadalupensis*	189.33 C	13.74 G	6.20 K	Female *penninsularis*	175.75 P	14.46 T	6.70 X
Male *penninsularis*	169.22 D	14.43 H	6.70 L	Female *sparverius* x *penninsularis*	187.62 Q	14.62 U	6.79 Y
Male *sparverius* x *penninsularis* intergrades	182.37 E	14.09 I	6.79 M	intergrades			

Comparisons

Means being compared	N_1	N_2	Difference	σd	$d/\sigma d$	P.*	Means being compared	N_1	N_2	Difference	σd	$d/\sigma d$	P.
	Males							Females					
Wing							Wing						
Means A and B	54	22	1.47	1.14	1.29	>.1	Means N and O	44	7	.28	1.91	.15	>.1
Means A and C	54	6	1.54	1.94	.79	>.1	Means N and P	44	8	20.68	1.90	10.88	<.01
Means A and D	54	9	18.57	1.53	12.14	<.01	Means N and Q	44	13	8.81	1.58	5.59	<.01
Means A and E	54	19	5.42	1.47	3.69	<.01	Means O and P	7	8	20.96	2.44	8.59	<.01
Means C and D	6	9	20.11	2.83	7.11	<.01	Means P and Q	8	13	11.87	2.47	4.81	<.01
Means D and E	9	19	13.15	2.89	4.55	<.01							
Culmen							Culmen						
Means F and G	45	5	.20	.31	.65	>.1	Means R and S	37	7	.14	.25	.57	>.1
Means F and H	45	7	.49	.27	1.85	.064	Means R and T	37	7	.01	.28	.04	>.1
Means F and I	45	14	.15	.20	.75	>.1	Means R and U	37	13	.15	.20	.75	>.1
Means G and H	5	7	.69	.29	2.36	.039	Means S and T	7	7	.13	.42	.31	>.1
Means H and I	7	14	.34	.25	1.39	>.1	Means T and U	7	13	.16	.36	.44	>.1
Upper mandible							Upper mandible						
Means J and K	45	5	.26	.20	1.31	>.1	Means V and W	38	7	.41	.15	2.70	.013
Means J and L	45	7	.24	.17	1.44	>.1	Means V and X	38	6	.12	.16	.73	>.1
Means J and M	45	15	.11	.13	.82	>.1	Means V and Y	38	12	.21	.14	1.49	>.1
Means K and L	5	7	.50	.20	2.56	.029	Means W and X	7	6	.53	.15	3.66	<.01
Means L and M	7	15	.13	.21	.63	>.1	Means X and Y	6	12	.09	.23	.39	>.1

*P. is a measure of significance of use similar to that of $d/\sigma d$, but much more reliable for the comparison of small samples. If P = .05 or larger, the difference of the samples is not shown to be significant; if P = .01 or less, the difference is almost surely significant; in the range from P = .05 to P = .01 the difference may be said to run from possibly to probably significant.

ments are generally not significant, except between the largest-beaked *penninsularis* and the smallest-beaked *guadalupensis*. Since the males and females independently follow the same pattern in beak size: *guadalupensis* < *sparverius* < *penninsularis*, it appears that the biological significance of the size of the beak is greater than the statistical significance.

SUMMARY

This study of variation in sparrow hawks is based on 678 specimens from western North America, of which 171 were collected in May, June, or July, and are presumed to be breeding or to have bred where collected.

Falco sparverius sparverius is the breeding subspecies from Alaska and northern Canada south to about latitude 30° 30′ N. on the Pacific coast of Baja California, but excluding the Colorado and Mojave deserts and the whole watershed of the Gila River. Color characters are unreliable in separating this subspecies from *F. s. penninsularis*. Measurements, especially of the wing, will distinguish all but about 3 per cent of the specimens.

The mean wing length of 54 males of *sparverius* of western North America is 187.79 ± .57; the standard deviation is 4.24 ± .44. Females are not only larger than the males, but are more variable as well.

Birds of the smallest average size come from the southern coastal part of the area studied, and those of the largest average size come from the northern interior.

Falco sparverius penninsularis has been collected in the breeding season from about latitude 30° 05′ N. southward in Baja California, and on Isla Carmen in the Gulf, and at Guaymas, Sonora. On the basis of other evidence it is concluded that this is the breeding race in coastal and southern Sonora, on the Colorado River delta, and in northern Baja California east of the Sierra Juárez and the Sierra San Pedro Martír.

The wing length of nine May, June and July males from Baja California is 169.22 ± 1.47; the standard deviation is 4.41 ± 1.04. It would appear to be safe to assign to *F. s. penninsularis* any male sparrow hawk with a wing length of 178 mm. or less taken in the indicated breeding range at any time of year, and any female similarly taken with a wing length of 186 mm. or less.

The name *F. s. guadalupensis* is proposed for the long-winged, small-beaked, light-collared race inhabiting Guadalupe Island.

In an area comprising the Colorado and Mojave deserts, the whole watershed of the Gila River and its tributaries, and southwestern Arizona south at least to the Mexican boundary, the breeding sparrow hawk population is extremely variable. Individuals typical of both *sparverius* and *penninsularis* occur. There is no evidence of interdigitation or overlapping of ranges. The east slope of the Sierra Juárez and the Sierra San Pedro Martír in Baja California, and probably much of the interior of the State of Sonora should be included in this area of intergradation.

F. s. deserticolus Mearns is clearly a synonym of *F. s. sparverius*. It was apparently based on a series consisting chiefly of migrant birds.

F. s. phaloena (Lesson) is not determinable from the description or locality, and the type is apparently lost. The probabilities seem strong that this name is a synonym of *F. s. sparverius*.

Sparrow hawks may breed when less than one year old.

First year birds disappear rapidly from the population after reaching a peak consisting of about two-thirds of the total population in August. Birds of the previous year make up only some 8 to 12 per cent of the population in the breeding season.

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