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TAXONOMIC AND ADAPTIVE FEATURES OF THE JUVENAL PLUMAGE IN NORTH AMERICAN SPARROWS

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TAXONOMIC AND ADAPTIVE FEATURES OF THE JUVENAL PLUMAGE IN NORTH AMERICAN SPARROWS

CHAPTER I

INTRODUCTION

Classification of birds, especially at the level of the genus and below, has to a large extent been based on the bill, foot, and plumage characters of museum specimens. In Ridgway (1901) the genera of passeriform birds are characterized mainly on the shape, size, and proportions of adult specimens. Many descriptions of immature birds are presented in this widely used work, and characters of immature birds are mentioned briefly, but the emphasis is on adult characters. Throughout the history of bird taxonomy there has been a tendency to describe immature specimens briefly or to ignore them entirely.

The above statements are not intended to be critical of any particular work, but they pose the question of why one age group of specimens should provide a more sound basis for classification than any other. Indeed, <u>does</u> one age group provide better criteria than another? This seems highly

unlikely in view of the variety of characters, behavioral as well as morphological, used in taxonomy, especially in recent years. Any conceivable character may be indicative of taxonomic relationship. Why, then, except in a few isolated cases, have immature plumages played such a minor role in classification of birds? The answer, lies, I think, in the fact that our knowledge of immature birds has consistently lagged behind many other phases of ornithology. The number of misidentified juvenal specimens I have encountered in the course of my study testifies to this. Misidentified birds have often been placed in the wrong genus, occasionally even in the wrong family. This is indicative of the tendency among ornithologists to ignore nestling specimens as a kind of nuisance. The paucity of juvenal specimens in most collections is significant. Collectors, whether consciously or not, have collected non-juvenal birds. Museums have preferred to pay for adult birds in breeding plumage. This avoidance of juvenal specimens has often been intentional because juvenals are not especially attractive, and they are sometimes difficult to prepare as study skins. Another important factor is the shortness of the period in which juvenal specimens are available each year.

In 1907 Pycraft wrote: "It is rather surprising that, while so much has been written about British birds, so little has been said about their nestling stages." Ingram (1920) stated: "There is no branch of ornithology that has remained

so long neglected as the study of nestling birds, nor is there one in which so many problems still await solution." The statement is nearly as true today as it was then, though there have been scattered contributions on the subject.

Ornithologists of this country showed comparatively little interest in juvenal plumages until 1878, when Brewster pointed out that the subject had been grossly neglected. There followed a rash of descriptions of juvenals, mostly by Brewster. The descriptions he published were excellent but his tendency was to describe the plumage without attempting in any way to interpret the distinctive pattern it presented. This tendency has persisted. Allen (1894) stated that the "first plumage" afforded clues to ancestral relationships, but he did not give any examples. He reiterated the old hue and cry that the subject was much neglected. Baird, Brewer, and Ridgway (1874) briefly described juvenal patterns of many North American birds, but they placed much more emphasis on egg characters in their taxonomy than on immature plumages. Dwight's (1900) classic work on the molts and plumages of the birds of New York State was descriptive, not interpretative.

Some authors have paid attention to characters of immature plumages in classifying birds. Seebohm (1890) attached significance to the condition of the young at hatching in broader classification. Lowe (1915) stated that down patterns were "absolutely diagnostic" for the shorebird sub-

family Erolinae, and pointed out the importance of examining color patterns in whole groups of related species. Ticehurst (1932) pointed out certain characters of the juvenal flight feathers in the Family Timaliidae. He deplored the paucity of juvenile specimens available for study. Pitelka (1951) used juvenal molts and bill colors in considering relationships of jays of the genus Aphelocoma, but ignored the juvenal plumage itself. Stejneger (see review in Ibis, 1883:383) used characters of the juvenal plumage in classifying North American thrushes. Ripley (1952) also used juvenal characters in his broad classification of thrushes of the world and their allies. Keeler (1893) discussed the evolution of color in birds and mentioned characters of the juvenal plumage of many species, though his emphasis was on characters of the adult. Other examples could be cited but the sum total of ornithological literature dedicated to such studies is very small.

CHAPTER II

METHODS AND SCOPE

Thorough search of the literature has not brought to light a single paper which, while dealing with relationships within a large number of related species, places emphasis on characters of the juvenal plumage. The present study is an effort in this direction. I have not attempted to classify North American sparrows solely on the basis of juvenal characters. This might be as misleading as basing classification on any other narrow range of characters. I have, rather, tried to ascertain how characters exhibited in the juvenal plumage fitted the accepted classification of one great group of North American birds; thus have I examined and evaluated certain ordinarily-not-used characters in the light of the requirements of any valid classification system.

This study is based almost entirely on juvenal specimens borrowed from various museums in the United States. It is not, I regret to say, based to any considerable degree on my own observations of growing nestlings. I have critically examined several hundred juvenal specimens representing the North American sparrows (Fringillidae), vireos (Vireoni-

dae), warblers (Parulidae), blackbirds (Icteridae), tanagers (Thraupidae), and weaver finches (Ploceidae), but I have here treated in detail only the fringillids and ploceids. Ideally such a study should cover all species of the families considered, as well as their nearest relatives, but for several reasons this was out of the question in the present case. Considering the availability of specimens, I decided to limit my study to North American (north of Mexico) genera of the families mentioned and to include as many New World species of these genera as possible. Nearly all of the Nearctic species, several Mexican species, and a few South American species are included. In a few cases, I have consulted published descriptions of juvenals of old world forms to see if a given pattern occurred. I have made detailed notes on specimens examined, and have prepared descriptions of the juvenal plumages, partly because adequate descriptions were not available for many species, but largely so that any other worker could re-analyze the information as he might choose. In this connection I have prepared photographic plates showing the juvenal patterns of nearly all the sparrows considered.

In an effort to determine the nature of differences in structure between juvenal and adult feathers I have examined microscopically both types for several species of sparrows. I have discussed the longevity of the juvenal plumage in some detail. Most of the data presented on the extent of

the postjuvenal molt are from published sources. I have presented data on the natal down wherever possible either from specimens I have examined or from published accounts. However, I have made no attempt to analyze characters of the down as a taxonomic aid because data are so incomplete. There is at present no source of information on the natal down, its color, length, distribution, or structure, for many North American sparrows, though the Bent "Life Histories" should fill this gap when completed.

The primary function of this study is to point out possible adaptive and taxonomic significance of the colors, patterns, and longevity of the juvenal plumage. This paper is in the nature of a foundation on which to base further work, and in this regard I have attempted to make note of special problems which need study, wherever I was aware of them.

Nomenclature and Terminology

I have followed, for the most part, the classification of Tordoff (1954), who places the cardueline finches in the family Ploceidae and recognizes three subfamilies of the Fringillidae, the tanagers (Thraupinae), the grosbeaks (Richmondeninae), and the Fringillinae. In so far as species classification and nomenclature are concerned, I have followed Hellmayr (1938). In a few instances I have diverged from this classification, but not without a discussion of

the reasons.

There has been considerable confusion in terminology of molts and plumages. Brewster (1878, etc.) described the juvenal plumage under the heading of "first plumage," an unacceptable usage since the first plumage in many birds is actually the natal down. Ridgway (1901) described juvenals under the heading of "young," a term which might apply equally well to down, juvenal plumage, or immature plumages of birds in winter.

I have used the terminology presented and fully discussed by Dwight (1900 and 1902), although I am inclined to believe that the term "juvenal," which he introduced, has caused as much confusion as it has prevented. It refers to the plumage which immediately follows the natal down, and to which the down is attached. It also refers to the bird which wears this plumage, or to a specimen in this plumage. I have regularly used the term in its broadest sense--i.e., for the plumage itself or for any specimen largely covered by the plumage. The word has gained such wide usage among American ornithologists that I have used it in this paper, though the familiar word "juvenile" seems just as correct in every way. "Juvenile" is in general use among British workers, and some ornithologists in America obviously prefer it.

CHAPTER III

DISCUSSION OF THE JUVENAL PLUMAGE

The sequence of plumages in American birds has been discussed by many authors, particularly Dwight (1900 and 1902), Stone (1896), and Chapman (1910-1932). The homologies of plumages in avian orders appear, however, to have received little attention. Percival (1942) indicated that the natal down in galliform, columbiform, and passeriform birds is homologous. Chandler (1916) discussed phylogeny of birds on the basis of feather structure in different orders, and considered the natal down in detail but not the juvenal plumage. Dwight (1902) inferred that the second (juvenal) plumage in species of several orders (Passeriformes, Galliformes, Charadriiformes, and Anseriformes) is homologous. There is no particular reason to question this, but the problem seems to deserve further study, since in so many groups there is no natal down; at least one family (Eurypygidae) has no juvenal plumage (Riggs, 1948); and in the strigid owls there are two "downy" plumages besides what is called the juvenal plumage. Certainly there is no reason to doubt that these plumages have homologs in various passerine families. It is also

clear that natal and juvenal plumages are of long standing in the Class.

Among perching birds the natal down is generally sparse, clothing the bird only very incompletely. That it functions regularly as insulator in this group seems highly unlikely, in view of its incompleteness, or absence, in some species. It is generally best developed on the dorsum, and Ingram (1920) suggested that it sometimes produces an effect of shadow which makes the nest look empty. Down is lacking in woodpeckers, but not by any means in all cavity-nesting birds. The plumage appears to be vestigial in the Passeriformes, a remnant of some more complete down covering, but this does not mean that it is without function, and the subject is another which deserves investigation in a large group of related species. I have no positive evidence that down is lacking in any of the fringillids considered here, but it is absent in two introduced ploceids (Passer).

By contrast the juvenal plumage is a definitely more complete one. It covers the body surface and functions as a protective, insulating layer. It provides the bird with its first flight feathers, an all important aid in escaping nest predators, yet it lacks the perfection of later plumages. It is a very lax plumage. Juvenal feathers possess the same qualitative structure as adult feathers, but the number of barbs per unit area is generally smaller, and this condition produces a less dense structure. Laxness is characteristic

of the juvenal plumage not only of passeriform birds, but of birds of other orders. At least in some Tinamiformes (probably), Galliformes, Charadriiformes, Cuculiformes, Columbiformes, Caprimulgiformes, Trogoniformes, and Piciformes this character is shown in specimens available to me. It is probably present in other groups, and certainly is widespread in the Class.

The character is well known among ornithologists, but perhaps it can be over-emphasized since adults in worn plumage (especially of the underparts) often have a plumage texture similar to that of juvenals. Several worn adult specimens were sent to me for juvenals, probably for this very reason. On the other hand, in some species the juvenal plumage is surprisingly firm and adult-like in texture. In certain goldfinches (Spinus) the juvenal plumage is so much like the winter plumage in texture and color as to be confusing. In Ammodramus (especially A. bairdi) the back plumage in juvenals is very like that in adults in texture. The texture of juvenal plumage, then, is variable from species to species, but within the species, and often within the genus, it is quite stable. Though the character of plumage texture is extremely difficult to describe, I believe that it has value in taxonomy, and I have placed some emphasis on it in considering relationships among the sparrows. For example, see discussion of Aimophila carpalis, below.

I am inclined to believe that laxness of juvenal

plumage serves no special function, and that in most cases the nestling is incapable of producing a firmer plumage. There is some suggestive evidence for this. To a certain extent thyroid hormone affects feather development. Sturkie (1954) has summarized literature on the subject. Thyroidectomized chickens have produced imperfect feathers which in certain respects (reduction of barbs and barbules) resemble characteristic juvenal feathers. Hutt (1949) informs us that slow- and rapid-growing (genetic) strains of chickens have different thyroid secretion rates, though I have not learned whether there is a difference in feather texture between the two groups. It is highly probable that other factors are involved in producing the characteristic "juvenal" texture of the second plumage, but a difference in hormonal balance seems to be indicated. Another point is that distal parts of the juvenal flight feathers, especially the rectrices, are often more flimsily constructed and less clearly colored than proximal parts developed when the bird is older and out of the nest. In this connection it should be pointed out that the juvenal plumage is not, in most species, a durable covering. I believe this is definitely correlated with its texture, and with its brief use by the bird. The plumage is eliminated by a molt (postjuvenal) which sometimes starts before all of the juvenal body feathers are even unsheathed. In the groups discussed here this molt nearly always begins before the juvenal plumage is many days old, i.e., the juve-

nal plumage is generally worn for a very brief period. An unnecessary molt is a biological extravagance. Why should a bird produce two sets of body-covering in a short period, wearing one a matter of days and the other (often) for a year? A logical answer is that presented above, namely that the young birds are incapable of producing durable plumage at the start.

There is further evidence for this point of view. The longevity of the juvenal plumage varies in different species, but nearly all of the material I have examined indicates that longevity is fairly uniform within the species. I know with certainty of only one passerine bird in the world which postpones the postjuvenal molt so that the juvenal plumage is regularly worn through the winter. This bird is the Himalayan Greenfinch (Hypacanthis spinoides), reported on by Whistler (1940), who also pointed out that the complete annual molt in Hypacanthis was a prenuptial spring molt, not a fall postnuptial molt such as is characteristic of other passerine birds. He confessed to being perplexed by this specialization, but the arrangement appears to be biologically sound. In many respects the greenfinch is a counterpart of the familiar New World goldfinches of the genus Spinus, being a small, brightly colored finch with call notes and nest-habits similar to those in Spinus. Like the Common Goldfinch (Spinus tristis) it breeds in late summer. A striking characteristic of the juvenal plumage in several

species of Spinus which I have examined is that it is quite durable, and in texture much like the winter plumage. Goldfinches at United States latitudes do not wear juvenal dress through the winter, but at least one species (psaltria) appears to do so in Central America. It should also be stated that the juvenal dress is comparatively long-lived even in northern populations of northern species of Spinus. These examples of apparent correlation between durability and longevity of the juvenal plumage, and elimination of an unnecessary molt, tend to support the hypothesis presented above.

Dwight (1900) pointed out that in some species ("especially Warblers and Vireos") the postjuvenal molt begins shortly after the young bird leaves the nest, but that in many other species the plumage is not molted for several weeks or even months. In a series of papers, Sutton (1935, 1936, 1937, 1941) pointed out certain misconceptions (traceable to Dwight) in regard to the length of the period that the juvenal plumage was worn by several species of Michigan sparrows. He showed that the molt often began much earlier in the bird's life than Dwight had indicated, and that in some species there was a particularly precocious development of new plumage in the scapular region. His study showed that in several species of sparrows some of the juvenal body plumage was replaced before the flight feathers were full grown, so that the juvenal plumage did not even attain a complete state.

In reviewing Sutton's (1935) paper, Ticehurst (1936) indicated that so far as he knew all European Passeres attained a complete juvenal plumage. This statement by a well known authority on molts and plumages of British birds is astounding, and, I suspect, grossly misleading. In nearly every stub-tailed juvenal I have seen, including one or two of British species, I have found an early development of winter plumage in the upper back and scapular region. All positive evidence available indicates that no North American fringillid or ploceid attains a complete juvenal plumage. The same is very likely true of the other nine-primaried families. I have noted the same condition in the Vireonidae, Parulidae, and Icteridae. The constancy of the feature, i.e., the precocious development of winter plumage in the back, may make it a valuable taxonomic character for broader classification of both passerine and non-passerine birds. I have observed its occurrence in other families: Tyrannidae (Sayornis phoebe, Empidonax wrighti), Alaudidae (Eremophila alpestris), Corvidae (Psilorhinus and Xanthoura), Mimidae (Mimus polyglottos), and Turdidae (Myadestes obscurus), but not the Troglodytidae (Thryomanes bewicki, Troglodytes aedon, Troglodytes troglodytes, and Uropsila leucogaster). I do not intend to dwell on the matter here, but it is a phenomenon which deserves careful analysis.

Sutton (1935) questioned whether the plumage which developed at this early stage was actually winter plumage.

From my study of prepared specimens I suspect that these early-developed feathers are of the winter plumage in most cases. The feathers appear to have a firm texture which contrasts with the surrounding juvenal plumage. In such species as Junco phaeonotus, the incoming feathers are solidly colored like winter feathers, not streaked as in juvenals; but in Carpodacus there is great similarity between juvenal and "first winter" feathers and it is impossible to be certain what generation of plumage is involved in this early development. Studies of the living bird are very much in order, for only from such studies will we learn what constitutes the juvenal plumage in any species. Sutton (1937) has shown that in the Chipping Sparrow (Spizella passerina) some precociously developed feathers of the crown and ventral pterylae do not replace other feathers. This, again, supports the view that the young bird cannot produce firm feathers from the very start, but that it can do so well before the flight feathers are full grown. In the case of the nestling Chipping Sparrow, certain feather buds do not, apparently, produce juvenal feathers or feathers of juvenal pattern and texture. When the young bird is somewhat older, these buds do produce firmer textured plumes. It is quite possible that this is exactly what happens in the case of the precociously developed back plumage, and I interpret the phenomenon as another mechanism by which unnecessary molt is eliminated.

Migratory Habits and Duration of Juvenal Plumage

Duration of juvenal plumage varies considerably among different species. It varies to some extent individually, but with few exceptions the specimens I have handled indicate that within a given species or race the plumage is consistently long-lived or consistently short-lived. Notwithstanding the early development of winter plumage in the back, as pointed out above, in some species no additional plumage change occurs for many days, or even weeks. All immature specimens of Red Crossbill (Loxia curvirostre) I have seen indicate that the juvenal body plumage is retained in this species until well after the flight feathers are grown. On the other hand, immature specimens of McCown's Longspur (Rhynchophanes mccowni) show that much of the juvenal body plumage is molted before the first flight feathers reach full length. It seems highly unlikely that I would have found one condition in over 21 Red Crossbill specimens, and another in several longspur specimens, wholly by chance. I have paid special attention to this longevity differential throughout my study, and have noted under the heading of the genus the condition found in each species. Juvenal plumage duration appears to have a genetic basis. It probably can be considered a species or race character.

Among species of a genus, even among closely related species, juvenal plumage duration may vary decidedly. The

variation appears to be correlated with differences in migratory behavior, though the correlation is certainly not absolute. In this respect the feature may have greater taxonomic value than has thus far been realized. Dwight (1900) first pointed out that the juvenal plumage in the Song Sparrow (Passerella melodia) is retained for a relatively long time. He suggested "several months," but this may be an exaggeration (Sutton, 1935). The Song Sparrow has migratory and non-migratory populations, and though I have not seen specimens of all races, I do know that the juvenal plumage is long-lived even in certain migratory forms. It is also long-lived in migratory races of its congeners lincolnii and iliaca, which suggests that it is a stable character in the group, thus supporting Linsdale's (1928) classification which lumps Melospiza and Passerella, a classification followed here for other reasons presented under Passerella. Non-migratory behavior and, incidentally, large size are apparently primitive in Passerella, while migratory habits are of comparatively recent origin in the group.

Generally there is positive correlation between short life of juvenal plumage and migratory habits, and between long life of juvenal plumage and non-migratory habits. Dwight's (1900) statement that in many species, "especially among the Warblers and Vireos, a moult begins . . . almost as soon as the birds leave the nest," takes on significance in the light of this correlation. Among warblers and vireos are

some of the most strongly migratory species, but the condition is not restricted to the warblers and vireos and it is not found in all species of these groups. In only three of the several species of the warbler genus Dendroica I have seen is the juvenal plumage retained until the flight feathers are full grown; but the plumage is quickly replaced even in these species about the time the rectrices attain full size, so it is never very long-lived. The species are coronata, its very close ally auduboni, and pinus. These are the least strongly migratory of the northern members of the genus, and pinus is resident in much of its range. I have seen no juvenal specimens of any of the southern non-migratory species of Dendroica.

This relationship between migration and rapid loss of the juvenal plumage appears to be biologically sound. The bird needs a good protective covering for migration; and it must grow this durable covering rapidly since it must store up an abundance of fat before migrating. Rapid replacement of the juvenal plumage would seem to be particularly important to young of late nestings in boreal areas. This combination may have afforded the stress which selected for short-life of juvenal plumage originally.

A number of boreal ploceids retain the juvenal plumage for a comparatively long period, but in no case that I know of are these species very strongly migratory. I refer particularly to the Evening and Pine Grosbeaks (Hesperiphona

vespertina and Pinicola enucleator), the leucostictes (Leucosticte), the crosbills (Loxia curvirostre and L. leucoptera), and the redpolls (Acanthis). These finches are given to wandering, but they have not developed regular migratory habits. Hesperiphona may be somewhat more definitely migratory than the rest, and its juvenal plumage is probably shorter-lived than that of any of the rest, though the bulk of it is retained well after the flight feathers are grown. With the exception of Hesperiphona, the juvenal plumage in these groups is rather dense and apparently quite durable, in comparison with that of many other passerines. There are also apparently adaptive features in the postjuvenal molt at least in Loxia and possibly in others. The molt proceeds slowly. This is indicated by specimens which have patches of both juvenal and winter body plumage but show no pin feathers as most molting birds do. The procedure seems to involve a replacement of juvenal plumage in patches, so that the body is well covered with feathers at all times. The advantage of this system to birds of a species which breed erratically in different seasons of the year and in cold regions may be real and not just apparent.

Non-migratory species of Mexico and Central America, e.g., Junco fulvescens and J. vulcani, which inhabit areas of temperate climate on mountain tops, also attain a complete juvenal plumage, and that of vulcani is an especially firm and durable plumage. Among tropical birds I would expect a

high percentage of species to retain the juvenal plumage, since many species in the southern latitudes are sedentary.

Species of the fringillid genus Zonotrichia present an interesting picture and possibly a natural test of the above-discussed hypothesis. Five species are known, four North American and one, capensis, Central and South American. There can be no doubt that capensis is a real member of the genus, and as Chapman (1940) pointed out, the characters of the juvenal plumage offer some of the best proof of this. All of the North American species are migratory and in all these species the postjuvenal molt proceeds rapidly and is well under way before the flight feathers are full grown. Zonotrichia capensis, however, is resident over the bulk of its range. Only in one race, Z. c. australis of Patagonia, has a migratory pattern developed. There are many distinct races of capensis, and in all of them a complete or nearly complete juvenal plumage is attained and worn for a long period. Chapman (op. cit.) presents sound reasons for believing that Zonotrichia capensis was isolated thus widely from other members of the genus during Pleistocene glaciation, and that this period marked the beginning of subspeciation. Australis, the most distinct of the races, may have been among the first isolated, but since it lacks the early postjuvenal molt characteristic of migratory species, I believe it evolved from non-migratory stock, and has had insufficient time to develop the condition. If early postjuvenal molt

does have value to migratory species, the condition may yet appear in australis.

Two migratory aparrows which retain their juvenal plumage well after the flight feathers are grown are Baird's Sparrow (Ammodramus bairdi) and Leconte's Sparrow (Ammospiza lecontei). In both species the juvenal dress is quite durable. In Baird's Sparrow it is nearly as firm-textured as that of the adult. The case is special, since both these sparrows regularly migrate in juvenal plumage, as indicated by several specimens at hand. The phenomenon has not been reported in the literature, though the occurrence of juvenal Baird's Sparrows in Arizona has given rise to the theory that there is a southern breeding ground for this species. The records are not reliable breeding evidence, however, since nearly all of them are for late summer and fall, and the only juvenal specimens I have seen from Arizona were full grown and conspicuously worn. The situation is probably no different from that of the Leconte's Sparrow, individuals of which appear well south of the breeding range in juvenal plumage or even in various stages of the postjuvenal molt. In this sparrow the postjuvenal molt does not involve the flight feathers. I have no data on the extent of the molt in A. bairdi; the whole molt may regularly be postponed until the bird is in its winter range.

The Leconte's Sparrow's retention of juvenal plumage may have taxonomic significance. For reasons stated below

(see Ammospiza) I believe that this species is much more closely related to the seaside sparrows (Ammospiza maritima and allies) than to the Henslow's Sparrow (Passerherbulus henslowi), with which it has generally been placed. Three southern species of Ammospiza are non-migratory (nigrescens, mirabilis, and some races of maritima), while the northern representatives of the genus do migrate; but in nearly all populations so far as I know the juvenal plumage is quite long-lived, and especially is this true among the resident seaside sparrows. A high percentage of juvenal maritima I have seen were badly worn, indicating long use. The condition is probably a stable one in the group, and has persisted in lecontei though that species has developed migratory habits. The Sharp-tailed Sparrow (A. caudacuta) may also migrate while in juvenal plumage. Since the juvenal plumage is durable in Ammospiza, migration of birds in that plumage is not surprising.

Exceptions to the molt-migration rule are, of course, to be expected. Notable exceptions are the cardinals, Richmondena cardinalis and R. phoenicea. The juvenal plumage in these species is quite soft and probably not durable, and in both it is lost quickly. Neither species is migratory, and phoenicea is restricted to the tropics.

Patterns of the Juvenal Plumage

Among passerine birds the natal down is virtually

without pattern, though it may vary slightly in color in different places on the body. In all later plumages, including the juvenal, there are various more or less complex color patterns. There is, of course, a vast literature on coloration in birds. A surprisingly small part of it has been dedicated to consideration of possible function of the patterns, and practically all of it has pertained to adult plumages. Friedmann's (1946) interesting paper on "ecological counterparts" is an example.

As a general rule colors in juvenal plumages are more subdued than those of adult plumages. In species where males are brightly colored and females are not, juvenals may bear resemblance to the latter, as in the Blue Grosbeak (Guiraca caerulea). In no case among the species studied is this rule excepted. Nestling birds in a number of species exhibit rather bright colors, but these colors are apparent in fleshy parts, and not in any case, so far as I know, in the plumage. Stub-tailed juvenals do not exhibit the striking bill and leg colors characteristic of adults in some species. With rare exception Dwight (1900) gives "pinkish buff" as the color for these parts in juvenals even in species of different families of birds. This may be somewhat misleading, but it is correct in so far as it implies lack of distinctive colors. In the Vireonidae, for example, blue leg color is characteristic of adults but not of nestlings or stub-tailed juvenals. Iris color in juvenals is usually dark brown even in species in

which adults exhibit bright eye-color, for example the Red-eyed Towhee (Pipilo erythrophthalmus). A similar phenomenon is exhibited in juvenal mammals, and this particular feature is not adaptive in any apparent way. It is evidently a natural process in maturation, but it tends to support the view that the nestling has a decidedly limited physiology.

It is altogether possible that this applies also to plumage color. A fact which supports this is that the distal few millimeters of the juvenal flight feathers are often poorly and unevenly pigmented.

The almost universal dullness of coloration in the juvenal plumage is, however, generally assumed to have survival value, and may actually be adaptive. The colors of most frequent occurrence in the juvenal plumage of sparrows are buff, brown, gray, black, and white. Pettingill (1948) has summarized the apparent functions of plumage color in adults. One of these functions is sexual recognition. Many species exhibit sexual dimorphism in juvenal plumage, but generally sexual characters are not as clearly exhibited in this plumage as in that of the adult, and often they are not apparent at all in the juvenal plumage, though prominent in the adult. Records of birds breeding in juvenal plumage are exceedingly rare, though older juvenal birds occasionally appear at the nest of an adult pair and sometimes help with nesting activities.

If the colors and patterns exhibited by the juvenal

plumage are functional, they are probably "concealing" or otherwise protective. The patterns of this plumage are sometimes the same as those of the adult; they are often strikingly different in some respect. With rare exception, juvenal North American sparrows have one or more of the specific plumage characters of the adult or of the adult female. These species-patterns are to be found on the head or back, or in the flight feathers. The patterns of the ventral surface are most often different from those in the adult. Among the sparrows studied the principal difference in ventral pattern between adult and juvenal plumage is one of presence or absence of dark streaks. Dorsally, adult and juvenal plumages exhibit one of two main patterns: a scaled pattern in which the feathers appear rounded distally, and are edged in light color; and a streaked pattern in which the feathers are dark medially, but margined laterally with light color. The back may, of course, be uniformly colored, without noticeable pattern. A distinctive cheek patch (dark auriculars, outlined by a light tone) may be apparent in the juvenal plumage, but this pattern is never more obvious in the juvenal than in the adult and usually it is less so. A pattern of wing-bars is produced in juvenal and later plumages by light tipping of the median and greater secondary wing coverts. This pattern is of very frequent occurrence in juvenals, and it often occurs in the juvenal plumage of species whose adult plumage is not so marked. If exhibited by the adult, it

always shows in the juvenal. One of the best characters for separating adult female Indigo Buntings (Passerina cyanea) from females of its close ally the Lazuli Bunting (P. amoena) is the conspicuous wing-barring in the latter, but in juvenal plumage both species plainly exhibit this pattern. Distinctive patches of solid color are generally lacking in juvenals, even though apparent in adults. Thus the Black-throated Sparrow (Amphispiza bilineata) lacks a black bib in juvenal plumage, though this is the most characteristic species-label of the adult. As a result the two species of Amphispiza (bilineata and belli) bear closer resemblance as juvenals than as adults.

The juvenal flight feathers need to be considered in connection with the postjuvenal molt. The extent of the postjuvenal molt varies in different species. It may also vary within the species, as Miller (1933) has demonstrated in Phainopepla nitens, though usually extent of molt is fairly constant and may be regarded as a specific character. Whistler (1941), Dwight (1900), and others have pointed out that the molt may vary in closely related species. Dwight (1900) and Chapman (1910, etc.) have presented information on this character for many U. S. birds, but data are still lacking for a large number of species. There are two general groups, birds which molt and replace all of their juvenal plumage, including the wing and tail feathers (complete postjuvenal molt), and those which molt and replace only the body

plumage and coverts, but not the flight feathers (partial postjuvenal molt). Some species have a molt which is intermediate in extent, but most species among the nine-primaried passerines studied have a partial molt, the flight feathers being retained generally through the bird's first year.

Flight feathers of the juvenal often show patterns of the adult, and this is a great aid in identifying puzzling juvenal specimens. Juvenal wing and tail feathers in some species have a characteristic shape and appearance, and this is particularly true of species having a complete postjuvenal molt. The appearance of the juvenal flight feathers may be indicative of the extent of the molt, but the character is not absolute. Juvenal rectrices are often rounded terminally, and appear less dense and firm than adult rectrices because they have fewer barbs per unit area and are consequently more fragile. The same is true of the remiges. Juvenal flight feathers vary in width, remiges being occasionally wider, rectrices frequently narrower than those of adults. These features offer valuable aids to age determination in birds, as in some woodpeckers, but the differences are frequently so subtle as to be of little help.

Adult-like remiges and rectrices in the juvenal plumage certainly appear to be an advanced character, with definite advantages especially to migratory birds. A complete postjuvenal molt probably represents a primitive condition, and it may be correlated with non-migratory habit.

In the Cardinal (Richmondena cardinalis) the juvenal flight feathers are obviously soft and "juvenal" in texture, and they are molted with the juvenal body plumage. The fact that many juvenals produce and retain firm adult-like wing and tail feathers is further evidence that there is an evolutionary tendency toward elimination of postjuvenal molt, or more to the point, of the soft juvenal plumage.

Possible Significance of the Juvenal Patterns

Sutton (1935) has discussed two "stages" of the juvenal plumage, pointing out that the plumage-stage before the bird leaves the nest is often strikingly different from that worn after it has been out a few days. Besides the change resulting from growth of the flight feathers, the body plumage often changes markedly in color tone, and even slightly in pattern, within a few days. Older juvenals with full grown flight feathers may often show wear and be faded to a considerable degree. In general, nestlings are darker in coloration than older birds, the patterns being more concentrated.

In some species, especially in the Richmondeninae and certain ploceids, juvenal feathers of the chin, throat, and sides of the head develop very slowly, and these parts may continue to be bare after others have a full plumage covering; but in all of the sparrows the general patterns of the juvenal plumage are clearly apparent by the time the bird

leaves the nest or shortly thereafter, and after the bird has been out of the nest a few days all of the body feathers generally are unsheathed. If the juvenal pattern has significance as protective coloration, the significance is not associated with the period of nest life, since the pattern does not become obvious until nest life is nearly over. Thus if a special juvenal pattern has survival value, it must be associated with the period of post-nestling life. This seems logical. The bird early in this stage is awkward and uncertain in its locomotion; furthermore its ecology is changed vastly and abruptly when it leaves the nest. Unfortunately the ecology of birds in postnestling life is a veritable hiatus in the literature in so far as most species are concerned. The habitat of the young bird is similar to, if not precisely the same as, that of the adult; but how the juvenal plumage functions in this habitat, how it serves the individual and therefore the species, is not known.

In considering the problem I have looked for similarity of juvenal pattern in ecologically associated species. Of the various patterns found in the 92 species considered here, only one pattern seems to occur consistently in a certain habitat and there only. A scaled back pattern occurs only in prairie species. In a brief discussion of juvenal pipits (Anthus), Shortt (1951) called attention to this scaled back pattern in certain open field birds. Among the prairie inhabiting sparrows, the pattern appears in Calamos-

piza, Ammodramus, Passerherbulus, Rhynchophanes, and Calcarius. It is not exhibited in adults of any of these but Ammodramus and Passerherbulus, and is not conspicuous in the adult even of these. The pattern is not exhibited in Passerculus or Pooecetes, though both of these inhabit the prairie; neither is it present in the Lapland Longspur (Calcarius lapponicus), a tundra species. It does appear in juvenals of the Horned Lark (Eremophila alpestris), however, which is widespread in both tundra and open field habitat. The inference is that a scaled back pattern has survival value in prairie or open field birds. Its occurrence in the juvenal but not the adult probably reflects the increased stress of juvenal life.

It seems probable that other juvenal patterns have survival value too, but this is not apparent to me in the group I have studied. Study of a large number of species from all parts of the world might lead to discovery of comparable pattern-habitat relationships. Too, a given pattern may have survival value in a number of habitats. The ecology of juvenals may be similar in different species regardless of habitat--i.e., of the plants they live in or under. If conspicuous ventral streaking has survival value at all, the pattern may be useful to forest species and to shrub-inhabiting species as well. The point I make is that many pattern-habitat relationships may exist without being at all obvious.

I have spoken of juvenal patterns as though they were

of universal occurrence among birds. This is definitely not the case, and it is informative to examine the taxonomic associations of juvenal pattern, especially among the nine-primaried birds, a group of related families generally regarded by taxonomists as a distinct unit. Mayr and Amadon (1951) have stated that the Vireonidae "may be the most primitive family of this assemblage." Their concept is based on wing formula and unspecialized diet. Juvenal vireos have no distinctive markings; they are very simple in pattern and, in general, bear resemblance to the adults. In the Wood Warblers (Parulidae) there is great variation in juvenal pattern. A very high proportion of the species are plain colored and also without distinctive marks as juvenals. In this category are species of the following genera: Protonotaria, Helmitheros, Vermivora, Parula, Oporornis, Geothlypis, Chamaethlypis, Icteria, Wilsonia, Cardellina, Setophaga, Myioborus, Euthlypis, and Basileuterus. Adults of many species have distinctive body plumage patterns, but juvenals lack these. In Mniotilta and Seirus there are body plumage patterns in both adults and juvenals, but no distinctive juvenal pattern. In pattern-characters the genus Dendroica appears to bridge the gap between the two groups of genera just listed. In this large genus some species (petechia, for example) have bold or striking patterns as adults but not as juvenals, while others (fusca, for example) are boldly patterned both as adults and as juvenals. The Parulidae are

considered primitive in this assemblage (Hellmayr, 1935; Mayr and Amadon, 1951). In the Icteridae there is variation in juvenal pattern. Juvenal orioles (Icterus) are without distinctive body patterns, while in Agelaius the juvenal has the complex pattern of the adult female. Juvenal cowbirds of the genera Molothrus and Tangavius are unique among North American Icteridae in being more complexly patterned than adults. In the Ploceidae considered here two genera, Spinus and Loxia, contain species with special (non-adult) juvenal patterns.

This brings us to the Fringillidae, which are of primary importance in the present study. Both Sushkin (1925) and Tordoff (1954) have suggested, on the basis of palate characters, that the Dickcissel (Spiza americana) is possibly an archaic fringillid, i.e., more representative of the ancestral form than any other extant species. The Dickcissel is a member of the "grosbeak" subfamily Richmondeninae, which is generally considered the least specialized group of the family (Hellmayr, 1938 and Tordoff, 1954), while the Fringillinae are considered more advanced. Tordoff (1954) believes that the tanagers are fringillids so places them in the subfamily Thraupinae, also an advanced group.

Several species in the Richmondeninae exhibit another trait which has been considered primitive (Bergtold, 1913), namely the delayed development of face plumage. Let us examine the juvenal patterns. Juvenals of Spiza are streaked,

often obscurely, on the back, but are without other markings, and in every respect are less distinctively patterned than older birds. In no species among the Richmondeninae here considered is there a juvenal (non-adult) pattern, and in all (six) of the genera juvenals of some or all species are plain-colored or are unmarked below. In the Fringillinae, on the other hand, 13 of the 20 genera I have studied contain species with distinctive juvenal pattern, and in the Thraupinae, the northern tanagers (Piranga) all have distinctive juvenal patterns. A distinctive juvenal pattern is, then, characteristic of groups which, on the basis of other characters, are considered advanced, while absence of juvenal pattern is characteristic of groups thought to be primitive. As already stated, the patterns involved in most cases are ventral or dorsal streaking, or both, or a dorsal scaled pattern.

I have inferred that the juvenal pattern or lack of pattern has value in classification in such major groups as sub-families, and that the bold patterns involved represent an advanced condition. In this regard comment on certain other families is in order. So far as I know, the woodpeckers (Picidae), which are considered primitive allies of the Passeriformes, are without distinctive juvenal patterns. The same is true of the flycatchers (Tyrannidae), also considered primitive passerines. Many of the true larks (Alaudidae) exhibit a juvenal pattern, but this fact does no necessarily invalidate the thesis that the juvenal pattern represents an

advanced condition, and it may indicate that a juvenal pattern is of greater value to ground nesting birds than to others, since the pipits (Motacillidae) also exhibit a pattern. The following North American passeriform families lack distinctive juvenal patterns: the flycatchers (Tyrannidae), swallows (Hirundinidae), crows and jays (Corvidae), titmice (Paridae), nuthatches (Sittidae), creepers (Certhiidae), wren-tits (Chamaeidae), dippers (Cinclidae), wrens (Troglodytidae), gnatcatchers (Sylviidae), silky flycatchers (Ptilogonatidae), and vireos (Vireonidae). Though there are no marked patterns in these groups, characters of the juvenal plumage may be of value in taxonomy among them. For instance, it has been suggested that the Corvidae and Paridae all belong to one family. The suggestion has not been taken very seriously by most ornithologists. A juvenal character which seems to differ consistently in the two groups is that of plumage texture. Juvenal crows and jays are instantly recognizable as juvenals because of the flimsy texture of their plumage, while juvenal titmice and chickadees are not readily separable from adults.

Besides the Alaudidae and Motacillidae already mentioned, four other passerine families in North America, the thrashers (Mimidae), thrushes (Turdidae), waxwings (Bombycillidae) and Shrikes (Laniidae), exhibit juvenal patterns. The feature is definitely associated with taxonomic groups, and should certainly be taken into consideration in classify-

ing even the broader divisions. The presence or absence of juvenal pattern does not necessarily prove closeness of relationship, of course. Thus while there is juvenal pattern in both the thrushes and waxwings, the pattern itself, and the plumage texture in each group, is distinctive. It should be pointed out that the juvenal pattern may vary at times in closely related species. The juvenal Rose-breasted Grosbeak (Pheucticus ludovicianus) is entirely without ventral streaking, while its sister species, melanocephalus, is finely but definitely streaked below. This difference is a significant warning that juvenal pattern might be misleading when used to interpret relationships, and that, in broad classification, emphasis should be placed on less variable characters.

I have given reasons for considering the occurrence of juvenal pattern an advanced character in nine-primaried passerine birds. Several authors, e.g., Mierow (1946), referring to the Pine Siskin (Spinus pinus), and Griscom (1937), referring to crossbills (Loxia), have implied that the juvenal plumage represents a primitive stage. This viewpoint presumably goes back to Haeckel and it is not necessarily incompatible with the statements made above, but it does bring up the question of the genetic relationship of juvenal and adult plumages, and the question of whether juvenal patterns are ancestral. The constancy of the juvenal pattern in a given population or a given species indicates genetic control. The mechanism may vary from species to species, and

I have no knowledge of this for even one species of sparrow. Warren (1929), reporting on work with domestic fowls, stated that the "relationships between down and adult plumage colors are . . . not of the nature of genetic linkages." Such statements do not, of course, take into account the juvenal plumage, and evidence for the sparrows must be circumstantial anyway.

The juvenal plumage appears to be conservative to change. In the genus Passerella, the species melodia, lincolni, and georgiana appear to be particularly closely related. In juvenal plumage all are streaked dorsally and ventrally and the three species resemble each other closely in this plumage. Adults of all three species are streaked dorsally, but only melodia and lincolni are conspicuously streaked ventrally. Georgiana appears to be plain-colored below, but actually it is obscurely streaked, the pattern being most noticeable on the flanks. Selection for plain breast in georgiana has not affected the juvenal plumage if the three species are monophyletic in origin as implied.

A number of similar examples among ploceids, fringillids, and related groups suggest that juvenal and adult plumages are under separate genetic control. Examination of the photographic illustrations of this paper will show how frequently the juvenal plumage is much the same within a group of related species whose adult plumages are strikingly different inter se. This fact tends to support the view that

the juvenal patterns actually are conservative to change. It also points out the potential value of juvenal patterns as indicators of the limits of monophyletic groups, and this may be the most important use of juvenal characters in taxonomy. Since juvenal patterns are generally conservative to change, assumption that ancestral Passerella was streaked in juvenal plumage may be valid, but nothing is inferred about the characters of the adult.

The assumption that a species is unspecialized because the adult resembles the juvenal is not warranted. All that such a resemblance implies is similarity of selective forces for both plumages, and selection not associated with sexual coloration but rather with cryptic or protective coloration. It should be pointed out here that characters of well marked races often show in the juvenal plumage exactly as in adult. Excellent examples of this are Passerella iliaca and P. melodia, both of which are highly polytypic plastic. The parallelism is not surprising. The two species are not far removed from each other either genetically or geographically, and they are subject to similar selective forces. Strong selective forces operating during the non-breeding season would tend to create differences between juvenal and adult, but the mortality rate in juvenal is far greater than that in older birds (Farner, 1945; Lack, 1943), so the juvenal period is the weak link in the post-nestling chain of development, and selection during the non-breeding season is comparatively less important.

CHAPTER IV

RELATIONSHIPS IN NORTH AMERICAN FRINGILLIDAE AND PLOCEIDAE

In the following discussion of relationships in and among genera of North American sparrows, juvenal characters are emphasized. For some groups a phylogeny has been suggested, usually on the basis of these characters.

Ploceidae (Cardueline Finches)

Hesperiphona (Plate 1)

With two species, vespertina and abeillei, each with several races, this Nearctic genus is a distinct, compact unit, showing no great variation in plumage, or in other characters so far as I know. Juvenal plumage patterns are similar to those of adults (sex for sex), being unstreaked both above and below. Juvenal males of vespertina lack the black crown of adult males. I have seen no juvenal male abeillei but the juvenal female has the patterns of the adult female, even the black crown. The juvenal plumage is comparatively long-lived in this species, the bulk of the juvenal plumage being retained until well after the flight feathers

are grown.

I have no specimens which show an early development of winter plumage in the upper back of Hesperiphona, though in both species I have found full grown flight feathers and winter plumage in the scapular region of the back of specimens which appeared otherwise to be in complete juvenal plumage. It is not surprising to find a long-lived juvenal plumage in these grosbeaks. Though vespertinainhabits boreal regions, it is not strongly migratory, while the southern abeillei is non-migratory. Magee (1926) implies that the postjuvenal molt proceeds very slowly in vespertina.

Dwight (1900) described the postjuvenal molt of vespertina as incomplete, involving the body plumage and wing coverts but not the rest of the wing usually nor the tail. In abeillei the extent of the molt is similar, at least in the female. There is no spring molt in vespertina.

Sushkin (1925) suggested that Hesperiphona was allied to the hawfinches (Coccothraustes) and other old world genera, particularly Perissospiza of the "Himalo-Tibetan" region. I have found no description of juvenal Perissospiza but juvenal Coccothraustes is streaked and quite different from the adult.

In North America Hesperiphona has no very close relatives. The juvenal plumage is plain as it is in the other ploceid grosbeak, Pinicola, but this similarity should not be emphasized in view of striking differences between the two

genera in bill shape and body proportions.

Carpodacus (Plate 2)

This genus is broadly distributed in both the old world and the new, but so far as I can determine from descriptions its several species are uniform in plumage character. The only species I have examined are the North American purpureus (two races), cassini, and mexicanus (several races).

The juvenal plumage exhibits the patterns and colors of the adult female; thus species characters and even racial characters are apparent in the juvenal, but juvenals and adult females of the three species all resemble each other closely. Juvenals of cassini and purpureus bear closer resemblance to each other than either does to juvenal mexicanus. The latter lacks a superciliary line, a pattern which is apparent in the other species. Even in adult plumage, purpureus and cassini are close, mexicanus having diverged both morphologically and ecologically (Salt, 1952). C. mexicanus is assigned by Ridgway (1887) to Burrica, a group Moore (1939) has discussed at some length. The outstanding character of Burrica is the nature of the postjuvenal molt. At this molt, in purpureus and cassini, males take on a female-like plumage, while in mexicanus males generally assume the bright colors of the adult male. As Moore (1939) pointed out, however, in some races of mexicanus young males resemble adult females after the postjuvenal molt. Another supposed

character of Burrica is the inconspicuously streaked back pattern. Some races of mexicanus are more streaked than others on the back, however, and California specimens of purpureus may be as obscurely streaked dorsally as any mexicanus I have seen. Creating a separate subgenus for mexicanus over-emphasizes the differences between species of Carpodacus, the more so since Burrica's principal character is so variable.

In Carpodacus of North America the postjuvenal molt is interesting and perplexing. As in many other groups, there is a development of fresh plumage in the upper back while the juvenal is still very young. I have noted this condition in juvenal purpureus with rectrices only 23 millimeters long, and have found it in various races of all three species. These incoming back feathers may be precocious winter plumage, but I have no positive proof of this. In cassini I find evidence of this molt in very stub-tailed specimens, and in specimens with full grown flight feathers. In juvenal male mexicanus these precocious back feathers should be more or less red if the incoming plumage is actually the first winter plumage. I have handled a few male juvenals of this species, and have observed the red-colored scapulars in none. The texture of these precocious feathers indicates that they are not regular juvenal feathers, and I am inclined to believe that they are winter plumage. Sutton (1935) has suggested the possible existence in some fringillids of a

postjuvenal plumage (neither juvenal nor winter). Carpodacus may have just such an intermediate plumage. The problem needs further investigation.

The postjuvenal molt in purpureus is incomplete according to Dwight (1900), involving the body plumage and wing coverts but not the rest of the wing nor the tail. I find no statement as to the extent of the molt in the other species. Chapman (1914) indicates that there is no spring molt in any of the three species under discussion. Witherby (1948) describes the plumages and molts of the European species erythrinus, making clear that they are similar to those of purpureus.

The patterns of juvenal Carpodacus bear resemblance to those of some other American ploceids (Spinus, Loxia), but on the basis of other characters (especially bill shape) these finches appear to have no very close allies in North America. Thompson (1894) recorded a hybrid between Carpodacus and Pinicola and Witherby (1948) juxtaposes the two genera in the Handbook of British Birds. Moore (1939) and others have suggested Asia as the probable center of origin of Carpodacus.

Pinicola (Plate 3)

The juvenal plumage of Pinicola has no very striking patterns. It is like that of winter or adult females, but the crown and rump colors are subdued. Pinicola is circum-

boreal and monotypic.

Most of the juvenal body plumage is retained until the flight feathers are full grown. There may be an early development of winter back and scapular feathers, but I have no data on this, except that full grown young birds which I have examined appeared to have firm scapular feathers though being otherwise in juvenal plumage.

Dwight (1900) described the postjuvenal molt as incomplete, involving the body plumage and wing coverts but not the rest of the wing nor the tail. Witherby (1948) described the postjuvenal molt in Pinicola e. enucleator of Europe; it is similar to that described by Dwight except that the primary coverts are not replaced. Pinicola has no spring molt.

Pinicola appears to have no very close relatives in North America. The unmarked juvenal body plumage of Pinicola is more like that of Leucosticte than of any other American (northern) ploceid. Because of this and for other reasons (see Leucosticte) I believe these two genera are more closely allied than either is to any other North American ploceid. French (1954) states that gular sacs are present in both groups. Both also have well developed hair-like feathers covering the nostrils. Hellmayr (1938) juxtaposes the two genera.

Leucosticte (Plates 4 and 5)

This American genus contains several closely related forms. Though the A.O.U. Check-List (1931) recognized three species, australis, atrata, and tephrocotis (with several races), Hellmayr (1938) included all forms under one species, tephrocotis. Examination of the juvenal plumage may shed some light on the matter. Adults of the three "species" are readily identifiable, though similar. Some juvenals probably could not be placed as to "species" without locality data, for in this plumage all forms resemble each other closely. There is greater difference between juvenals of two races of tephrocotis (littoralis and dawsoni) than between juvenals of the race dawsoni and the "species" australis. Grinnell (1913) selected a juvenal specimen for his type of L. t. dawsoni, thus calling attention to the distinctive character of this particular plumage. In most groups the juvenal plumage is more conservative to change than the adult plumage, and this would appear to be the case in Leucosticte.

Most juvenal Leucosticte can be placed as to "species": atrata is duskiest, australis grayest, tephrocotis brownest. There is no difference in pattern. All are plain colored below and obscurely streaked above. Wing patterns are similar. Species are not merely morphological entities, however, and this statement is pertinent in considering Leucosticte. All the forms have narrow ecological latitude

and changes in any of the populations would presumably occur slowly if leucostictes are well adapted to their specialized environment. Furthermore, changes in one population might readily be paralleled in another since selective forces in such similar habitats should be similar. A very important point is that three and possibly more of the populations of Leucosticte are now completely isolated. In view of the above facts it seems likely that they have been isolated for a long period, and though morphological differences between tephrocotis, atrata, and australis are not great, any difference at all is significant.

Similarity does not end with plumage. The three "species" are alike in their breeding habits (see Ray, 1910; Lincoln, 1916; and Miller, 1925).

The juvenal plumage is worn for a long period in all "species," most of it, if not all, being retained long after the flight feathers are grown. There is, however, an early development of fresh (winter, probably) feathers in the back. These appear before the rectrices are half grown. Whether or not these represent an actual replacement of juvenal feathers, most of the juvenal plumage remains.

Chapman (1913) says that the postjuvenal molt is incomplete, involving the body plumage and lesser wing coverts but not the rest of the wing, nor the tail. He believed the molt to be similar in all forms. Grinnell (1913) stated that there is no spring (prenuptial) molt.

The characters of juvenal Leucosticte are unlike those in any other northern ploceid except Pinicola. The patterns of the juvenal plumage are similar in the two. That this indicates closeness of relationship seems at first to be far-fetched, but the birds are morphologically similar in two other characters: firm nostril feathers (found also in Acanthis and Spinus) and gular sac. The general ecology of the two is different, but the niches they occupy are adjacent in montane areas. The two are widely differentiated but of North American Ploceidae, Pinicola is the closest ally of Leucosticte.

Acanthis (Plate 6)

Acanthis has long been a storm center of controversy among taxonomists. British workers have placed it, with Spinus, under Carduelis. Lacking material from abroad, I have followed most American authors in using it exclusively for the several redpolls. Salomonsen (1928) and Hellmayr (1938) placed the redpolls in Acanthis, regarding the genus as monotypic. Witherby (1948) and others considered it ditypic, the species being flammea and hornemanni. Taverner and Sutton (1934) at Churchill, Manitoba, and Wynne-Edwards (1952) on Baffin Island, found that these two forms intermingled during the breeding season yet maintained their genetic entity despite similarity of habit and ecology. In juvenal plumage the two species appear to be readily separable.

Juvenals are profusely streaked dorsally and ventrally, hornemanni being more finely streaked and whiter (paler) throughout than flammea. Witherby (1948) stated that certain racial characters were obvious in the juvenal plumage of redpolls.

The juvenal plumage in itself is of little help in deciding the relationship of these two forms. A series of juvenal hornemanni from Southampton Island deserves more detailed discussion in this regard, however. Three males in the series are very uniform in their characters and identical with a Canadian specimen which I have seen. A juvenal female which was collected with one of the males is very much darker in all parts, in this respect being like flammea. Since this is not normal sexual dimorphism for hornemanni it may deserve other interpretation. If it shows the normal variation within the species, then the characters which are used to separate flammea from hornemanni are certainly far from absolute.

The juvenal plumage is long-lived in Acanthis, but in both hornemanni and flammea there is an early development of a subsequent plumage (presumably the winter plumage) in the region of the upper back, while the rectrices are still very short. I do not know whether juvenal plumage is replaced by these incoming feathers, but most of the juvenal plumage is retained until after the flight feathers are grown.

Dwight (1900) stated that the postjuvenal molt in

flammea was incomplete, involving the body plumage and wing coverts only. Witherby (1948) stated that one or two secondaries were often replaced in this species, but that in the race cabaret coverts, along with the flight feathers, were not molted. There is no spring molt in flammea. I have found no description of the molts in hornemanni. They certainly deserve investigation in view of this form's remarkable relationships with flammea.

The characters of the juvenal plumage and postjuvenal molt in Acanthis are similar to those of other American ploceids, particularly Spinus pinus. The juvenal plumage patterns are much like those of Loxia and Carpodacus.

Spinus (Plate 7)

Some taxonomists (Witherby, 1948) include this genus along with Acanthis (redpolls) in Carduelis, following the classification of Hartert (1903). Most American ornithologists, however, place siskins and American goldfinches in Spinus. A survey of juvenal plumage characters might shed light on the problem if enough material were available.

Specimens of several American species which I have seen do indicate that the juvenal plumage has value in determining relationships within the genus. Many species of Spinus are South American, and their juvenal plumages are probably largely unknown. Only the North American and Mexican species, pinus, atriceps, notatus, tristis, psaltria, and

lawrencei are considered here. In adult plumage all species but pinus are plain colored, pinus being heavily streaked above and below. In juvenal plumage, however, atriceps and pinus are identical in their patterns, both resembling adults of the latter. The adult female of atriceps has streaked under-tail coverts, but otherwise there is no hint in the adult plumage that the juvenal would resemble pinus. Ridgway (1901) suggested that, on the basis of wing-tail proportions in adults, these two species were close. The closeness seems the more probable because of the similarity of the two species in juvenal plumage. Dickey and Van Rossem (1938) stated that some female notatus from El Salvador had the crissum streaked. I have seen one similarly streaked specimen (immature male) of notatus from Chiapas. The irregular occurrence of this pattern in notatus may indicate close relationship, also, with atriceps and pinus. These species show the transition between the two groups which are radically different in plumage pattern. Juvenal tristis and psaltria (northern populations) are plain colored and very like winter birds, even in the texture of their plumage. Juvenal lawrencei diverges conspicuously from the other species in being mottled or inconspicuously streaked with buffy gray below. It may be a relict member of the genus, as indicated also by its very limited range.

I have not found in juvenals of any species an early development of winter plumage in the upper back, but most of

the plumage is quite long-lived in all species, being retained until after the flight feathers are grown.

Dwight (1900) and Chapman (1910) presented data on the molts of pinus and tristis, and Chapman discussed psaltria and lawrencei. S. tristis and pinus both have an incomplete postjuvenal molt involving the body plumage but not the wings nor tail. Northern populations of psaltria may also have an incomplete molt, since the juvenal rectrices appear to be retained in winter. Dickey and Van Rossem (1938) reported that the postjuvenal molt in El Salvador was complete. With the molt, young birds attained the high plumage of adults. The molt occurred in spring, however, rather than fall. The molts of this species throughout its range offer an interesting problem.

I have found no published data on the molts in notatus or atriceps. The molt in lawrencei is incomplete involving the body plumage, but not the tail feathers, remiges, or primary coverts (Chapman, 1910). S. lawrencei apparently has no spring molt, again in contrast to tristis and pinus, which with their prenuptial molt replace part or all of the body plumage, but not the wings nor tail. In tristis this molt varies geographically in degree of completeness (Dwight, 1902). In northern populations of psaltria the prenuptial molt is complete. This fact, in the light of what Dickey and Van Rossem have presented on the species in El Salvador (see above), suggests that the juvenal plumage may be retained

through the entire winter. This winter-long retention of juvenal plumage, which may well be unique among North American birds, has a remarkable parallel in the old world where another goldfinch-like species, Hypacanthis spinoides, wears its juvenal plumage through the winter.

The juvenal plumage in Spinus is firm and durable, and its early replacement by a similar plumage would seem to be a biological extravagance. It is logical, then, that one or more of the goldfinches may have evolved a delayed post-juvenal molt. This condition should be looked for among South American Spinus.

The patterns of juvenal and adult Pine Siskins are very like those of such other American ploceids as Acanthis, Loxia, and Carpodacus. Both Acanthis and Loxia are placed near Spinus by Hellmayr (1938), and juvenal plumage characters support such a classification. The Pine Siskin has been considered primitive because the juvenal and adult plumages are similar, but on the basis of pattern characters I would consider both pinus and atriceps advanced. What of the distribution of the several species? S. atriceps has a very limited range in Middle America. S. pinus is the most widely distributed North American member of the genus, and the most decidedly boreal. The species spinus, of the old world, is apparently very close to pinus, resembling the American species in all plumages. It is difficult to interpret the zoogeographic data, because so many old world species have been

lumped under Carduelis. I think this is a valid criticism of the lumped classification. The Redpolls certainly are not obviously members of the siskin-goldfinch group, whereas "Carduelis" spinus is.

Loxia (Plate 8)

Loxia is a holarctic genus of three species, ranging southward to the Philippines in the old world and to Central America in the new. All specimens I have seen, and descriptions read, indicate that the crossbills are uniform in plumage characters. The juvenal plumage is always heavily streaked both above and below. The two species which occur in America, curvirostre and leucoptera, also are widespread in Eurasia, and certain species characters are as apparent in the juvenal as in any later plumage. Juvenal curvirostre and leucoptera are more alike than adults, juvenal curvirostre having narrow whitish edgings on the median and greater coverts and, distally, on the tertials. These edgings suggest the wing-pattern of leucoptera in any plumage, and they are not evident in any later plumage of curvirostre. Griscom (1937) mentioned the rare occurrence of wing-barring in curvirostre in the old world. For zoogeographic and other reasons, Griscom believed that leucoptera represented the primitive type. The patterns of juvenal curvirostre, discussed above, support Griscom's belief.

Loxia curvirostre and leucoptera are similar in other

respects. The juvenal plumage persists long after the flight feathers are grown. The plumage is dense and durable, an adequate covering for species that over most of their range are exposed to a rigorous boreal climate. Dwight (1900) stated that the postjuvenal molt in both species was incomplete, involving the body plumage but not the wings nor the tail. Tordoff (1952) discussed this molt in curvirostre, and Kenneth C. Parkes (personal communication) is making an intensive study of the molts and plumages in leucoptera. Witherby (1948) presented data on the molts in some European forms. After examining a good series of juvenal curvirostre in the Denver Museum of Natural History I believe that the feather development of the nestling and stub-tailed juvenal in this species is much more complex than is currently realized. I doubt that thorough knowledge of the juvenal plumage and first molts can be attained from museum specimens only. The living nestling must be studied. I have been unable to ascertain whether there is precocious development of postjuvenal plumage in the scapular region.

Several authors have pointed out that the nestling crossbill possesses a straight, uncrossed bill like that of other "sparrows." As to the distinctness of the genus and the close alliance of its species there can be little question, as Griscom (1937) has pointed out. The closest allies of Loxia--Acanthis, Spinus, and Carpodacus--have almost identical juvenal patterns. Griscom (1937) indicated that Loxia

probably originated in the old world. Its nearest allies are probably to be looked for in Asia.

Fringillidae

Subfamily: Richmondeninae

Spiza (Plate 9)

This American genus contains only one extant form, the Dickcissel (Spiza americana). Sushkin (1925), stated that Spiza was probably an isolated and archaic form. Tordoff (1954) reviewed the classification of Spiza and included it with the grosbeaks (Richmondeninae) as did Hellmayr (1938), suggesting that on the basis of palatal structure, it was a generalized (primitive) fringillid.

The juvenal plumage exhibits no distinctive pattern, being streaked on the back somewhat as in later plumages, and plain below. Chapman (1911) called attention to the similarity between juvenal Dickcissels and juvenal House Sparrows (Passer domesticus). Later plumages (immature birds and adult female) of Spiza are sparsely streaked ventrally, but there is no indication of this pattern in the juvenal. This lack of distinctive pattern, a feature of other Richmondenines also, may logically be considered an unspecialized or primitive condition.

Gross (1921) reported that the juvenal plumage was very short-lived, one individual having started the molt on its eighteenth day. Specimens I have handled indicate that

this early advent of winter plumage is usual. The molt often begins before all the juvenal body feathers are unsheathed. The molt of the ventral pterylae appears to begin as early as that of the back region, and may actually precede it slightly. The rapid loss of the juvenal plumage may well be correlated with early post-nesting migration. In the summer of 1953 while studying birds along the coast of eastern Mexico I noted that Dickcissels were among the earliest southward-moving transients from the United States.

During the postjuvenal molt only the primaries, secondaries, and tail feathers are retained. (Gross, 1921 and Chapman, 1911.) Chapman states that there is a spring molt restricted to anterior parts of the body.

The Dickcissel has no obviously close allies. Spiza townsendi (Audubon), a form known from one specimen, is apparently extinct.

Richmondena and Pyrrhuloxia (Plate 10)

Mayr and Amadon (1951) have included the cardinals and pyrrhuloxias under one genus, Pyrrhuloxia, though this classification has not been widely accepted. Richmondena contains two species, phoenicea of South America and cardinalis (with races). Pyrrhuloxia is monotypic (with races).

In plumage characters, the juvenal Cardinal and juvenal Pyrrhuloxia are very similar. Neither has a marked pattern, and each resembles the adult female of its respective

species. To this extent juvenal characters appear to support combining the genera. Pattern character should not be overemphasized, however, since unpatterned juvenal plumage appears to be the rule rather than the exception in this subfamily.

Sutton (1935, 1941) has discussed the development of juvenal cardinalis. Mrs. John Whitaker has lent me her notes on juvenal Pyrrhuloxia. I have seen only two specimens of juvenal phoenicea, and have found no published data on the young of this species, but it is very much like cardinalis in appearance and in other respects. The development of the juvenal plumage in the R. cardinalis and Pyrrhuloxia is similar. In both species there is a late advent of juvenal feathers about the eyes and chin. Bergtold (1913) mentions this as a feature of pterylosis in primitive birds. Juvenal Pyrrhuloxias and Cardinal develop a crest at about the same stage of growth, at about two weeks of age.

In the Pyrrhuloxia there is an early development of winter plumage in the upper back and on the breast. Sutton (1935) mentions the appearance of fresh pin feathers in the 15-20 days old Cardinal. In R. phoenicea there appears to be an early development of winter scapulars, and the molt is well under way in the breast before the flight feathers are full grown. In none of these species is a complete juvenal plumage attained, the juvenal body plumage being quite short-lived.

The postjuvenal molt of Richmondena appears to differ in extent from that of Pyrrhuloxia. Dwight (1900) and Sutton (1935) stated that the molt of R. cardinalis is complete. The flimsy appearance of flight feathers in juvenal phoenicea suggests that the molt is probably complete in this species also. Male phoenicea attain bright red plumage with the postjuvenal molt as does northern cardinalis.

Miller (1913) indicated that the juvenal flight feathers in Pyrrhuloxia were not regularly replaced in the molt. Mrs. Whitaker's notes show that only the body plumage, wing coverts and tertials were replaced in a captive young Pyrrhuloxia, and the condition of these feathers in juvenal specimens which I have seen indicates that they, and they only, would be replaced. There appears, then, to be a distinct difference in the extent of the molt in Pyrrhuloxia and Richmondena, both of which are non-migratory. There is no spring (pre-nuptial) molt in either.

The outstanding difference between Richmondena and Pyrrhuloxia is that of bill shape. The strong arching of the culmen is apparent even in very young (stub-tailed) Pyrrhuloxia.

Pyrrhuloxia and Richmondena phoenicea are poorly known. Before the Mayr and Amadon (1951) classification can be accepted, both groups should be studied further.

Guiraca (Plate 11)

Despite the breadth of its range (southern U. S. to Middle America), the Blue Grosbeak (Guiraca caerulea) shows surprisingly little variation in plumage characters (Dwight and Griscom, 1927). The juvenal plumage has the patterns and colors of the first winter plumage, or of the plain brown form of the adult female (without blue); it lacks a distinctive pattern. In this respect Guiraca is like most other richmondenines. Except in the adult male, later plumages are sparsely and obscurely streaked. The same sequence of pattern is shown in several other richmondenines. This situation is quite the reverse of that found in most of the fringillines studied.

As in the Cardinal (see Richmondena), development of juvenal plumage on the chin, throat, and sides of the head is slow in nestling Guiraca. The juvenal plumage of the head is barely unsheathed before the molt is under way, so the juvenal plumage, of U. S. birds at least, is very short lived. Dickey and Van Rossem (1938) mention an El Salvador specimen in "pure juvenal plumage." The flight feathers of this specimen were not necessarily full grown, but the juvenal plumage may be longer-lived in more southern populations than in northern. If so, the phenomenon presents another example of correlation between migratory habits and longevity of the juvenal plumage.

Dwight (1900) stated that the postjuvenal molt was incomplete, involving the body plumage and wing coverts, but not the flight feathers. Immature birds undergo an extensive spring molt involving part of the body plumage and coverts, rectrices, and sometimes the remiges (Dwight, 1900, and Dickey and Van Rossem, 1938).

Sushkin (1925) stated that Guiraca stood "in no near relation" to Passerina; also that Cyanocompsa was a near relative of Richmondena and distinct from Guiraca. Juvenal Guiraca and Cyanocompsa are quite similar, and on the basis of the juvenal characters, Richmondena, Guiraca, and Cyanocompsa appear to be more closely related to one another, than any one of them is to Passerina or Pheucticus.

Pheucticus (Plate 12)

I have seen neither specimens nor description of juvenal aureo-ventris of South America, so the following remarks refer to the more northward ranging species, ludovicianus, melanocephalus, and chrysopeplus. Though distinct in all plumages there can be no doubt about the close relationship of two former in view of similarities in breeding habits and song, and the occurrence of hybrids (Cockrum, 1952). In all three species the juvenal has the head and back patterns of the adult female, but not the ventral pattern. In ludovicianus, adult females are heavily streaked below while juvenals of both sexes are immaculate below. In melano-

cephalus, females and juvenals are much more nearly alike, both being sparsely and inconspicuously streaked. Female chrysopeplus is not conspicuously marked below; the juvenal is finely streaked on the jugulum and the sides of the chest.

For reasons already discussed I consider absence of pattern to be a generalized (primitive) condition, and by this criterion ludovicianus is probably the primitive member of the group. Zoogeographic data supports this, since ludovicianus is the most widely separated from its congeners during the breeding season and also the least plastic (on the basis of named races). The pattern of the adult male, furthermore, is quite different from that of other species. P. melanocephalus is more plastic and wide-ranging (breeding season). The species of this genus show a transition from primitive, plain-patterned condition to more specialized patterns.

Dwight (1900) described the postjuvenal molt in ludovicianus as incomplete, involving the body plumage and wing coverts, but not the rest of the wing, nor the tail. There is a partial prenuptial molt in immature birds, involving "the body plumage, the tertiaries, most of the wing coverts and the tail." Chapman (1912) said that the postjuvenal and prenuptial molts in melanocephalus were similar to those of ludovicianus. Michener and Michener (1951) believed that the postjuvenal molt of melanocephalus in California involved some primaries also.

In both species there is a precocious development of winter plumage in the upper back. These winter feathers are well developed pin quills before the rectrices are a third grown. There is no evidence of such early development in the juvenal chrysopeplus at hand.

I have no other data on the longevity of the juvenal plumage in ludovicianus. Several specimens of melanocephalus which I have seen show that the juvenal plumage is short-lived, much of it being replaced by the time the rectrices are full grown. A specimen from southern Mexico indicates that the bulk of the plumage may be retained longer in southern than in northern populations, for though it has winter plumage in the back and scapular region, its plumage otherwise is juvenal, and the tail is over three-fourths grown. This specimen probably represents a non-migratory population, as the species winters commonly in southern Mexico. I suspect that the juvenal plumage is lost quickly in ludovicianus, a strongly migratory species. In collections which I have visited there have been a few stub-tailed juvenal specimens, none with rectrices more than a third grown. This indicates that the molt takes place rapidly and early, since young juvenals are less likely to be collected than those which can fly well.

In North America none of the allies of Pheucticus appear to be exceptionally close. The genus is properly considered a member of the Richmondeninae, and on the basis of

its juvenal characters I would consider it more specialized than Pyrrhuloxia, Richmondena, or Guiraca.

Passerina (Plate 13)

Of this new world genus I have seen juvenal specimens of all the species--rositae, versicolor, leclancheri, ciris, cyanea, and amoena. In recent years no authority has questioned the close relationship of these species within the genus.

In regard to juvenal characters there appear to be two distinct groups in Passerina, but this may not indicate diphyletic origin since rositae has intermediate characters. As in Pheucticus, some species have distinct ventral streaking; others do not. All species show juvenal patterns ventrally, and I believe Passerina to be, like Pheucticus, a more advanced member of the northern Richmondeninae. Plain, unstreaked patterns in some juvenals and adults supports including Passerina in the Richmondeninae.

Three species, cyanea, amoena, and rositae, have definitely streaked ventral patterns in juvenal plumage. None of the other species show this pattern, and no Passerina is boldly streaked on the dorsum, though both amoena and cyanea are obscurely streaked there. Ciris, leclancheri, and versicolor, though unstreaked ventrally, are definitely darker on the chest and sides than on the rest of the underparts. This may be a stage in the development of a streaked pattern,

since such a pattern is produced by broad light edgings on feathers which are dark medially. Juvenal amoena, cyanea, and (less definitely) rositae have wing-barring. In so far as adults are concerned only amoena has wing-bars.

In texture and pattern of the juvenal plumage, ciris, versicolor, and leclancheri are very close, though readily identifiable. These species exhibit juvenal features which I consider to be primitive in the Richmondeninae. I do not discount the possibility that they belong in a different genus from amoena and cyanea, but the possibility seems remote. P. rositae is very like ciris and leclancheri in the texture of its plumage, though certain of its patterns are those of amoena and cyanea. The wing-barring in rositae is very much subdued, in this respect approaching ciris.

That cyanea and amoena are sister species is indicated by similarities in the juvenal and other plumages, as well as by similarity of behavior, etc. Hybrid specimens have been reported (see Cockrum, 1952:149). In juvenal plumage both species have distinct wing bars. Juvenals have other patterns in common, as indicated above, and resemble each other closely. On the basis of juvenal characters I consider them the most specialized members of the genus, showing relation to versicolor, ciris, and leclancheri only through rositae.

I have little data on the longevity of the juvenal plumage in most species of Passerina. In cyanea and amoena there is an early development of winter plumage in the upper

back region. Sutton (1935) stated that in cyanea the molt began when the bird was about 16 days old. The molt proceeds rapidly and much of the juvenal plumage is replaced by the time the rectrices are grown. I suspect that the juvenal plumage is similarly short-lived in amoena. In leclancheri the juvenal plumage may persist longer. This is indicated by a specimen from Oaxaca with full grown flight feathers and largely juvenal body plumage. Leclancheri is non-migratory and long retention of the juvenal plumage is not surprising.

Dwight (1900) discussed the molts of cyanea and ciris, Chapman (1911) of cyanea, amoena, ciris and versicolor. I have found no published data on the molts and plumages of leclancheri or rositae, and very little on versicolor. The postjuvenal molt in cyanea is incomplete, involving the body plumage, wing coverts, and sometimes the tail feathers and outer five or six primaries. A specimen in the Sutton Collection suggests the possibility that the molt might regularly (not just occasionally) involve tail and wing feathers. The specimen was collected by P. Slud in Costa Rica (far from the breeding grounds), November 22, 1952. The skull is described on the label as "clear," indicating that the bird was hatched in the 1952 breeding season. The specimen is largely in first winter body plumage, but all of the rectrices and the outer primaries are short and sheathed at their bases, and pin feathers are scattered throughout the body plumage and wing coverts. This bird almost certainly

migrated in its juvenal flight feathers and was undergoing the last stages of the postjuvenal molt on its wintering grounds. If this procedure is characteristic of cyanea, the postjuvenal molt of flight feathers would not be detected among specimens collected in this country except "sometimes." The problem is one which should be borne in mind by collectors in Mexico and Central America.

The postjuvenal molt in amoena is also incomplete, involving all the plumage but primaries, secondaries and rectrices (Chapman, 1911). In ciris the postjuvenal molt is nearly complete (Storer, 1951).

The first breeding plumage is acquired by cyanea through an extensive, though usually incomplete, prenuptial molt (Dwight, 1900). No one has reported on the spring molt in amoena in detail. Chapman (1911) indicates that there is such a molt, and states that the male Lazuli Bunting wears a female-like plumage in its first breeding season. In both versicolor and ciris the first breeding plumage of males is similar to the female plumage. There is no spring (prenuptial) molt in ciris, and I find no evidence of such a molt in versicolor. Adult male ciris, unlike cyanea, wears its bright plumage through the winter.

Even among the few species of Passerina for which there are data, there is considerable variation in the extent and frequency of molts. P. ciris appears to differ from cyanea in its molts as well as in juvenal plumage characters.

This feature may have taxonomic significance, but until data are available on all of the species we cannot evaluate them. I know nothing of the song of leclancheri or rositae; in the other four species it is many-phrased, tuneful, and distinctive. Each species can be identified by song, but songs of the four species resemble each other. I consider this a strong argument against splitting the group.

Subfamily: Fringillinae

Plectrophenax (Plate 14)

The juvenal Snow Bunting (Plectrophenax nivalis) has the somewhat vague patterning of the adult in winter. The back is obscurely streaked while on the chest the streaking is very faint--if perceptible at all.

The juvenal plumage offers no clue as to the affinities of this species. There is an early development of winter feathers in the scapular region of the upper back. The postjuvenal molt of lesser coverts proceeds quickly and the juvenal plumage is short-lived, apparently never becoming complete. According to Dwight (1900), the postjuvenal molt is incomplete, involving body plumage but not the wing nor tail. Specimens which I have examined show that the lesser coverts are also replaced. Immature birds have a restricted spring molt of feathers of the chin, throat, and sides of head.

Tordoff (1954) has suggested, on the basis of palatal

characters, that the Snow Bunting is among the most primitive of the Fringillinae. The absence of distinctive juvenal patterns is further evidence that the form is to be regarded as primitive. Plectrophenax is among the very few fringillines lacking distinctive juvenal patterns.

Sporophila (Plate 15)

Most species of this large genus are South American, and I have seen juvenals of only one, Sporophila torqueola of southern Texas, Mexico and Central America. I tried to borrow specimens of the Mexican species minuta and aurita, but found none in juvenal plumage. Specimens of these species in postjuvenal plumage indicate that the molts and sequence of plumages in Sporophila are probably much more complex than in most fringillid genera, but a comparison of juvenals will be impossible until more specimens are collected.

The juvenal Sporophila torqueola has the patterns of the adult female, plus a pale nape patch, which the female lacks; it is unstreaked, but has two conspicuous wing bars. The few specimens I have seen indicate that the plumage is short-lived. As with many other sparrows, there is a precocious development of winter feathers in the upper back before the rectrices are half grown. The oldest juvenal I have handled showed that body plumage and lesser and median coverts are replaced in the postjuvenal molt, but I am uncertain about the flight feathers and primary coverts. The juvenal

rectrices are rounded, with medial shaft, and are quite different from those in winter specimens. They are probably replaced in the postjuvenal molt.

Hellmayr (1938) included Sporophila in the Carduelinae. Tordoff (1954) placed it in the Fringillinae, and his evidence, based on palatal characters, is convincing. As a fringilline it is unusual in that its juvenal plumage-patterns resemble those of the grosbeaks and their allies (Richmondeninae). No other fringilline considered in the present study is entirely unstreaked in any plumage, and this, so far as I can determine, is characteristic of the entire genus. Dickey and Van Rossem (1938) have indicated that several generations (plumage) are necessary for males to reach mature plumage. This condition also resembles that of certain of the grosbeaks, which group Hellmayr (1938) and Tordoff (1954) consider primitive.

Arremonops (Plate 16)

I have seen no juvenal specimens of Arremonops tocuyensis. The other two species recognized by Hellmayr (1938), rufivirgatus and conirostris, are much alike in all plumages and resemble each other closely as juvenals. Juvenals are streaked or mottled with dusky both above and below and have head patterns somewhat like those of adults. Neither rufivirgatus nor conirostris is migratory. In both species the juvenal plumage is thin and flimsy, not durable. Im

rufivirgatus it is very short lived, much of it being molted before the rectrices are grown. Chapman (1914) stated that the postjuvenal molt in this species is incomplete, involving the body plumage but not the flight feathers. Todd (in Carriker, 1910) said that the postjuvenal molt of conirostris in Colombia involved "only the body plumage and the wing coverts." Specimens I have handled indicated that the tertials are sometimes replaced in both rufivirgatus and conirostris.

A. rufivirgatus and conirostris certainly are closely related. Carriker (1910) stated that their nests and eggs (unmarked white) are very similar. Hellmayr (1938) indicated that Arremonops might be allied to the Green-tailed Towhee (Chlorura). In juvenal plumage Chlorura bears some resemblance to juvenal Arremonops, especially A. rufivirgatus. In other respects Chlorura and Arremonops are quite different, the juvenal plumage and nesting habits (including marked eggs) of Chlorura being much more like those of Pipilo. The juvenal plumage of Arremonops is similar in its texture and patterns to that in some species of Aimophila, another group in which the eggs are unmarked.

Chlorura (Plate 18)

Ridgway (1901) called this monotypic genus "intermediate between Pipilo and Zonotrichia, though much nearer the former." Shufeldt (1888) believed it to be closer to Zonotrichia than Pipilo, on the basis of skull characters. The

adult Green-tailed Towhee (Chlorura chlorura) has patterns and colors found also in certain species of Pipilo, especially ocai.

Chlorura is migratory. Its juvenal plumage is short-lived. There is a precocious development of winter feathers in the scapular region of the upper back when the rectrices are less than half grown, and by the time the tail is full length, the postjuvenal body molt is well under way. This molt is somewhat like that in Pipilo. According to Chapman (1914) it is incomplete, involving all the plumage but the rectrices, remiges, and primary coverts. In retention of primary coverts, it is like Pipilo though in Pipilo the tail feathers are also replaced. Inclusion of the Green-tailed Towhee in Pipilo does not seem justified solely on the basis of similarity in juvenal plumage, for its juvenal patterns are found in several other sparrows, especially Arremonops. The two genera do appear to be closely allied, however.

Pipilo (Plates 17 and 18)

Five full species of this genus are currently recognized by several authorities: erythrophthalmus, ocai, fuscus, aberti, and rutilis. Their relationships are complex, as indicated by Sibley (1950), who studied variation in adult plumages of red-eyed members of the genus, and by Davis (1951) who studied variation in the adult plumages of the brown towhees.

I have not seen juvenal rutilus, nor have I found a description of the plumage. Juvenal plumages of the other four species are not uniform in their patterns, but may, in spite of this, be informative as to relationships of and within the genus. Ridgway (1901), in characterizing Pipilo, stated that "only the young" are streaked below. This statement may be misleading, since juvenal aberti is very obscurely streaked below, if at all. Davis's (1951) only comment concerning the juvenal plumage in the brown towhees was: "Juveniles are at once distinguished from immatures and adults by the extensive streaking and spotting of the underparts."

Despite the great variation in colors and patterns of adult Pipilo, it is now clear that ocai and erythrophthalmus are closely related. Certain populations of the two intergrade freely (Sibley, 1950). Though these two species are clearly distinguishable in juvenal plumage, their closeness of relationship is much more apparent in juvenals than in the adults, as indicated by the following juvenal patterns which they have in common: dorsal and ventral streaking, the ventral heaviest on the breast in both; superciliary lines, most prominent anterior to the eye; well defined wing bars. None of these characters is shared by both species in adult plumage, a fact which points to the more conservative (to change) nature of the juvenal plumage.

Quite distinct from either of the above-discussed species in any plumage are the brown towhees, fuscus, rutilus,

and aberti. In adult plumage these species resemble each other, but no intergradation between them has been reported. Juvenal rutilus is apparently unknown, but fuscus and aberti are very different as juvenals, fuscus being white below, heavily streaked and spotted with dusky on the chest and sides, while aberti is light buffy brown all over, without definite streaking either above or below. The texture of the juvenal plumage in the two species is decidedly different, that of aberti being comparatively firm or dense. P. aberti is proportionately much longer tailed; it is also a much shyer bird. Pipilo aberti and fuscus may, indeed, be genericly distinct. They have much in common, however, and unless other evidence is brought forward, I suggest that the nomenclature remain unchanged. Since some specimens of juvenal aberti exhibit vague ventral streaking, this character should not be over-emphasized. Davis (1951) has pointed out that aberti is very much more restricted in its habitat requirements than fuscus, a difference which may well be reflected in juvenal plumage differences. Bendire (1890) found eggs of the two species to be very similar. Differences between the two species certainly are no greater than between the brown towhees as a group and the red-eyed towhees as a group.

Davis (1951) has suggested, on the basis of similarity in characters of the adult plumage and in breeding biology, that Melozone of Mexico and the brown towhees are closely related. He believed the brown towhees to be more closely

allied to Melozone than to the red-eyed towhees. I have seen no specimens whatever of juvenal Melozone. Juvenals of the two groups should be compared.

In aberti and erythrophthalmus a complete or nearly complete juvenal plumage develops, most of it being held until well after the first flight feathers have reached full length. Stub-tailed specimens of fuscus (nominate race and mesoleucus) which I have handled show an early development of winter plumage in the interscapular region. The juvenal plumage in fuscus and ocai is apparently not so long-lived as in aberti and erythrophthalmus; in full-tailed young fuscus and ocai examined by me the body plumage was obviously in a state of molt. Dwight (1900) called the postjuvenal molt of Pipilo erythrophthalmus incomplete, involving all feathers but the primaries and their coverts and the secondaries. There is apparently no spring molt. Chapman (1912) stated that fuscus and aberti had the same postjuvenal molt pattern as that of erythrophthalmus. P. fuscus and aberti have no prenuptial molt. Specimens of ocai which I have seen indicate that its molts are similar to those in other towhees. Ridgway (1901) recognized that there were two groups of towhees in the genus Pipilo, and Davis (1951) believed that placing the brown towhees and red-eyed towhees in the same genus was artificial.

It is my opinion that Pipilo is not a monophyletic group. I consider aberti primitive among the brown towhees

because of its lack of juvenal pattern. While erythrophthalmus is plastic it is primitive in that it holds its juvenal plumage a long time.

Calamospiza (Plate 19)

The juvenal Lark Bunting (Calamospiza melanocorys) exhibits the general patterns of the winter plumage of the adult female, but possesses a "scaled" back pattern (not apparent in later plumages), as do juvenals of several other open field birds. It lacks the distinct pectoral spot of the following plumage, and exhibits an obscure median crown-stripe which is not present in any later plumage.

There is a very rapid development of winter plumage in the scapular region and upper back, which starts while the tail is very short. Much of the plumage is retained until after the flight feathers are grown, but the plumage is short-lived, never attaining a complete state.

Chapman (1914) stated that the flight feathers were retained but that all other plumage was replaced in the post-juvenal molt. There is a spring molt of body plumage by males at least.

This monotypic genus has no close allies in North America. It has certain patterns in common with Chondestes, but I think this is coincidence, and not indicative of close relationship. The juvenal scaled back pattern is an advanced character for open field birds. Calamospiza is strongly di-

morphic sexually and has many plumages, yet over a breeding range from Saskatchewan to southern Texas no geographic variation has been described.

Passerculus (Plate 20)

Peters and Griscom (1938) believed that this genus contained a single wide-ranging species, P. sandwichensis, with numerous intergrading races. I have seen juvenal specimens of only two of the races, but these were from different corners of the continent. I have not seen a juvenal of P. s. princeps or of any member of the P. s. rostratus group, both of which have been considered by some authors to be distinct species. Juvenal princeps has, however, been described by Dwight (1900).

The juvenal plumage in Passerculus has the same general patterns as the adult, but generally lacks a pectoral spot. Juvenals vary geographically, but not always as the adults do, subspecies for subspecies. Thus stub-tailed juvenal P. s. alaudinus from southern coastal California are very finely and sparsely streaked ventrally and the dorsal plumage is broadly margined with grayish white. These are not characters of adult alaudinus, but rather of the adjoining race, P. s. nevadensis. This discrepancy between racial characters of adult and juvenal plumages may be further indication of the conservative (to change) nature of the juvenal plumage. It may, on the other hand, be indicative of subtle differences

in the ecology, and therefore of selective forces, of adult and young. A detailed study of geographic variation within a single species is outside the scope of the present paper, but I wish to emphasize the need for such a study, particularly here. There have been a number of studies of the Savannah Sparrow's geographic variation, but the juvenal plumage has not received much attention in any such study. This may be due, in part, to a paucity of comparative material in collections.

In Passerculus there appears to be the usual early development of some winter feathers in the upper back. Several specimens of P. sandwichensis savanna at hand show that the bulk of the juvenal plumage is held until after the flight feathers are grown. There is thus a lull in the molt between the time the first winter back feathers appear and the molt in other parts of the body begins, as in several other sparrows. Sutton (1935) reported a rapid molt. According to Dwight (1900) and Sutton (1935) the molt is incomplete, involving the body plumage and coverts but not the flight feathers. There is, according to Dwight, an extensive, though incomplete, spring molt (of both immatures and adults) involving much of the anterior body plumage and the tertials but not the rest of the wings, nor the tail.

Beecher (1955) evidently believed that Passerculus and Ammospiza should be merged. Certain facts do, indeed, point to a close relationship between the two groups. Both

have a much more extensive prenuptial molt than most sparrows, and this molt involves no marked pattern change in either group. To some extent their ecology is similar, though throughout much of its broad range Passerculus inhabits grassland. The lack of a scaled back pattern (the back is streaked in both genera) in the juvenal is significant, since this pattern is common to most prairie birds, and Passerculus is plastic in other respects. The situation is just the reverse of that in Calamospiza. These facts tend to support Beecher's view, but uniting the two groups would seem to greatly over-emphasize the nearness of their relationship.

Ammospiza (Plate 21)

In this genus I place the Leconte's Sparrow, which in juvenal plumage has the patterns of juvenal Ammospiza caudacuta and A. maritima, but not of Passerherbulus henslowi.

I have seen no juvenal specimens of the Cape Sable Seaside Sparrow (Ammospiza mirabilis), a form endemic to southern Florida and very restricted in its range. Griscom (1944) believed this bird to be a well defined race of maritima. Several authors have discussed the taxonomy of the Seaside Sparrows without even mentioning the juvenal plumages. These certainly deserve careful study.

In the species of Ammospiza which I have seen, the juvenal is distinctively streaked on the back, and the head patterns and ventral pattern are like those of the adult.

The character of the ventral streaking may be sexual. It is variable in the forms I have examined. Most juvenals of Ammospiza caudacuta are virtually unstreaked though some (males especially) are conspicuously streaked on the breast. Juvenals of the various races of maritima, and of such caudacuta as I have seen, exhibit the same racial characters as adults. The coastal races of caudacuta approach maritima, but the similarity is more apparent in adult plumage than in juvenal.

Beecher (1955) discussed his concept of the evolution of Ammospiza, though he does not include lecontei in the genus, inferring that the Savannah Sparrow (Passerculus sandwichensis) really belongs in Ammospiza. The Savannah Sparrows and Sharp-tailed Sparrows certainly are allied, but placing Passerculus in Ammospiza would seriously alter the uniformity of that genus.

The juvenal plumage in Ammospiza is long-lived. A. maritima is not strongly migratory and the juvenal plumage of this species is held fully two months (Dwight, 1900). All juvenal maritima I have seen were badly worn. There is a precocious development of winter plumage in the scapular region in caudacuta, and almost certainly also in maritima and lecontei. Full grown juvenals of these species invariably have in the scapular region some winter feathers which appear to be worn to the same degree as the surrounding juvenal feathers.

Both caudacuta and lecontei are strongly migratory. A. lecontei regularly migrates in juvenal plumage or while the postjuvenal molt is in progress. Dumont (1934) collected four "juvenal" Nelson's Sparrows (A. c. nelsoni) in Iowa where caudacuta is not known to breed. I wrote to him in 1954, asking for details, but received no answer. I am inclined to believe that the birds he collected were immature, not really juvenal. The fact that lecontei does migrate when in juvenal plumage is well substantiated by a number of specimens in the Kansas University and Oklahoma University Museums. This migration in juvenal plumage favors the view that lecontei evolved from non-migratory stock in which the juvenal plumage is long-lived.

So far as I can determine from available specimens, the postjuvenal molt in lecontei is incomplete, involving the body plumage and wing coverts, but not the flight feathers. According to Dwight (1900), the molt of caudacuta is also incomplete but more extensive, involving usually "the entire plumage except the primaries, their coverts, and the secondaries." According to Chapman (1910) the molt of maritima is the same as that of caudacuta, but Dwight (1900) called it complete. Dwight pointed out that the prenuptial molt in caudacuta was complete in both immature birds and adults. Tordoff and Mengel (1951) showed that lecontei also had an extensive prenuptial spring molt. Maritima apparently has no spring molt (Dwight, 1900). I have found no published

data on the molts in mirabilis and nigrescens. Juvenal nigrescens is decidedly blackish and its patterns are like those of the adult.

Passerherbulus (Plate 22)

The taxonomic history of this genus was summarized by Tordoff and Mengel (1951), who suggested that Leconte's Sparrow (Passerherbulus caudacutus of the A. O. U. Check-List) was more closely allied to the Sharp-tailed Sparrow (Ammospiza caudacuta) than to the Henslow's Sparrow (Passerherbulus caudacutus). Their suggestion was based largely on the occurrence of an extensive spring molt in both the Leconte's and the Sharp-tailed Sparrow, but not in the Henslow's Sparrow.

The characters of the juvenal plumage clearly indicate that Leconte's Sparrow is a distinct inland species of Ammospiza, not of Passerherbulus, its affinities with Henslow's Sparrow being not very close. This recommended classification involves a nomenclatural change, since the specific epithet caudacuta is already occupied in Ammospiza. The name lecontei is available (Ridgway, 1901), so the name of Leconte's Sparrow should be Ammospiza lecontei. The juvenal Leconte's Sparrow, like other juvenal Ammospiza, has a distinctively streaked back pattern. The head and ventral patterns are similar to those of the adult.

The juvenal Henslow's Sparrow has a "scaled" back

pattern; the head pattern is similar to that of the adult; and the under parts are unmarked. The plumage is different in pattern from that of any Ammospiza (including lecontei) I have seen.

Sutton (1935) and Dwight (1900) described the post-juvenal molt as complete. As in Ammospiza the plumage is fairly long-lived, but there is an early influx of winter feathers in the scapular region (Hyde, 1939, and Sutton, 1935). Dwight reported a partial prenuptial molt (in spring) of feathers of the head and chin in both immature and adult birds.

The molts in Passerherbulus are exactly like those in Ammodramus savannarum (Dwight, 1900). Passerherbulus has other features in common with Ammodramus, probably its closest ally, but the immaculacy of its underparts when in juvenal feather is a significant difference.

Ammodramus (Plate 23)

The two species of this genus, savannarum and bairdi, are very much more alike as juvenals than as adults. Adult bairdi bears a striking resemblance to the Savannah Sparrow (Passerculus sandwichensis), and Ridgway (1901) placed the species in a monotypic genus (Centronyx) between Passerculus and Coturniculus (= Ammodramus), stating that it was much closer to the latter. He did not mention the juvenal plumage in his discussion of the relationships of the three forms,

but the characters of the juvenal support his view that bairdi and savannarum are close. Certain patterns are common not to juvenal or adult savannarum but to juvenal savannarum and adult and juvenal bairdi. I refer particularly to markings on the chin and side of the head and the conspicuous ventral streaking. Juvenals of both species have a scaled back pattern. This pattern appears to be an adaptive feature in prairie birds, but juvenal Passerculus does not have it despite the fact that Passerculus and Ammodramus are prairie associates in the many areas throughout which their ranges overlap.

A striking feature of the juvenal plumage in Ammodramus is its firm texture. In this respect, the plumage is like that of the adult. This is particularly true of bairdi, in which the juvenal plumage appears to be long-lived. The occurrence of juvenal specimens and worn adults in Arizona has led to speculation concerning a discrete southern breeding range. Among the many bairdi records listed by Cartwright, Shortt, and Harris (1937) were several southern records of juvenals. In every case these were late August or September records. I have seen three such specimens, worn birds in the early stages of the postjuvenal molt. Such specimens are not reliable evidence of breeding, though stub-tailed juvenals would be. The number of records of juvenals south of the known breeding range of bairdi indicates that this species migrates often and probably regularly in juvenal

plumage. This is also true of Leconte's Sparrow (Ammospiza leconteï), though the two species are not particularly closely related. Ammodramus savannarum appears to complete its molt before migrating, but this is difficult to prove. Because of the much broader range of savannarum, migration of juvenals in this species can be proved only through banding.

In both species of Ammodramus there is a precocious development of winter plumage in the scapular region of the upper back, but the bulk of the juvenal plumage is retained until well after the first flight feathers are grown. Sutton (1935, 1937) discussed the development of the juvenal plumage and the early stages of the postjuvenal molt in savannarum. Dwight (1900) described the molt of this species as complete, and mentioned a partial prenuptial molt (spring) involving mainly feathers of the head and anterior portions of the body. There is a similar spring molt in A. bairdi, as indicated by the only adult specimen at hand, but I have found no published data on the molts of this species.

The nearest ally of Ammodramus is probably Passerherbulus henslowi. The three species are similar in habitat, and all have a scaled back pattern in juvenal plumage. Their molts are similar, so far as I know. The underparts of juvenal Passerherbulus are immaculate, of juvenal Ammodramus, streaked.

Pooecetes (Plate 24)

Sutton (1935, 1941) reported on the juvenal plumage and postjuvenal molt of the eastern race of the Vesper Sparrow (P. g. gramineus). Juvenal specimens of the western race, confinis, which I have seen, show the same patterns as those of eastern birds. The molt in confinis corresponds to Sutton's description of that in Michigan birds.

The patterns of juvenal Poocetes are almost exactly like those of the adult, though usually there is no pectoral spot. The lesser coverts are not solidly colored as in the adult, but they are edged with light rufous and this suggests the pattern in the adult. The plumage is very short-lived. Sutton (1941) showed that the postjuvenal molt began in some eastern birds on their eighteenth day. Winter feathers appear very early in the scapular region, at the bend of the wing (lesser coverts), and on the crown. The molt proceeds rapidly.

Geographic variation is evident in the juvenal plumage, western individuals having more white in the back plumage (the back feathers have broad light margins) than eastern.

The postjuvenal molt, according to Dwight (1900) and Sutton (1941), is incomplete, involving the body plumage and wing coverts but not the flight feathers. If there is a prenuptial molt of any sort, it is slight, involving feathers of the head.

Pooecetes has no close allies in North America. The streaked (not scaled) back of the juvenal plumage is a primitive character of species which inhabit grassland, as the Vesper Sparrow does. Pooecetes has other patterns in common with Passerculus, but the two are very different in some respects. The song of Pooecetes is complex, in this respect resembling that of the Lark Sparrow (Chondestes). Pooecetes has some patterns (distinct auricular patch, pectoral spot, and white in the tail) in common with Chondestes. In the texture of their plumage, especially the juvenal plumage, the two genera are markedly different, and I suspect that they are not closely related.

Chondestes (Plate 25)

The juvenal Lark Sparrow (Chondestes grammacus) has the same patterns of head, face, and upper parts in general as that of the adult. Ventrally, however, the plumage is conspicuously streaked. Usually it does not have the conspicuous pectoral spot of later plumages.

There is a precocious development (before the rectrices are half grown) of firm winter feathers in the upper back region, but I do not know how long the juvenal plumage is held. Some juvenal breast feathers are retained until after the flight feathers are grown, but I suspect that the body molt is well under way by the time the rectrices attain full length. According to Dwight (1900) the postjuvenal molt

is complete and the prenuptial spring molt is confined to the head.

Juvenal plumage characters may be of little help in working out the relationships of Chondestes, a genus widely considered to be monotypic. The texture of the plumage is distinctive, being like that of juvenal Aimophila carpalis, and very different from that of Pooecetes. Ridgway (1901) and Hellmayr (1938) both place Chondestes near Pooecetes. I suspect that the relationship between these two is no closer than that between either and any of several other fringilline genera. Hellmayr (1938) placed Chondestes near Aimophila, a sound arrangement on the basis of juvenal characters. Chondestes often nests on the ground in a grassy place, but absence of scaled pattern is not surprising for it is not a true grassland species.

Aimophila (Plates 26 and 27)

This large genus has long been a problem group. I have seen specimens of ten of the fourteen species listed by Hellmayr (1938). Dr. Robert W. Storer of the University of Michigan informs me of a study he has carried out on relationships of and within the group. He has emphasized the juvenal characters in his analysis, an all but unique approach. His paper is now in press. Dr. Storer searched far and wide for juvenal specimens to be used in his study, and he has kindly provided me with material on certain species, including a

photograph of notosticta. He was unable to acquire juvenal quinquestriata and strigiceps. I have not seen specimens of these three species or of petenica.

The remaining ten species, cassini, botterii, ruficeps, rufescens, aestivalis, carpalis, ruficauda, sumichrasti, humeralis, and mysticalis, are a heterogeneous assemblage at best, even in juvenal plumage. The group may not be a natural one. Ridgway (1901), who was evidently perplexed by the genus, suggested five subgroupings of the 12 North and Middle American species without bestowing subgeneric names. His groups were: rufescens, notosticta, and ruficeps; ruficauda, humeralis, and mysticalis; sumichrasti and carpalis; quinquestriata alone; aestivalis and botterii. Cassini he did not mention in his groupings. He concluded that, on the basis of proportions and certain adult plumage patterns, the assemblage should be regarded as one genus. A pattern he did not stress, but which is fairly constant among the ten species here considered, is the "mustache" pattern at either side of the chin and throat. Another character is the immaculacy of the eggs.

Storer (personal letter) refers to Aimophila as a "scrap-basket" genus. In juvenal characters, Ridgway's Aimophila is not as uniform as other genera of North American Fringillidae, and subdivision might give us a more satisfactory or usable classification. The old genus Peucaea, which included cassini, botterii, and aestivalis, is a natural

group of closely related species. Aestivalis has a somewhat more specialized habitat than the other two species, so its being somewhat removed from them morphologically is to be expected. This is also the last of Ridgway's "groups." Classification of the other species is not so easy, and my ideas concerning the "best" linear arrangement of species differ markedly from those of Ridgway.

On the basis of the patterns and texture of juvenal plumage, I believe that of the ten species here considered, carpalis and mysticalis are most nearly allied to the "Peucaea" group, and closest to them is aestivalis.

Pitelka (1951), reviewing the history of nomenclature of carpalis, confirmed Van Rossem's (1936) belief that this species belonged in Spizella. Pitelka's stand was based on similarity in behavior. The juvenal plumage patterns of carpalis tend to support this view, since juvenal carpalis is strikingly like juvenal Spizella breweri. However, the plumage texture of juvenal carpalis is unlike that in any Spizella, and much like that in its congener, mysticalis, as well as in Chondestes (which some authors consider close to Aimophila), and Amphispiza. Carpalis has other Aimophila plumage characters: a "mustache" pattern; square-tipped, not pointed, rectrices; and graduated tail-shape. These are not characters of Spizella. Furthermore, though the juvenal pattern is Spizella-like, it does not differ greatly from that of A. mysticalis. The eggs of carpalis are unmarked. The consist-

ent immaculacy (so far as known) of eggs in Aimophila makes this an important character. In Spizella eggs are consistently marked, though Maris (1895) reported a set of unspotted eggs of the Chipping Sparrow (S. passerina). In view of the facts presented, I believe that the similarity in pattern between juvenal carpalis and juvenal Spizella breweri is a coincidence without taxonomic value, and that the former species should be retained in Aimophila, its nearest ally being mysticalis. Hellmayr's (1938) suggestion that carpalis and sumichrasti might be conspecific is highly unlikely. In juvenal plumage the two are markedly different in pattern and even somewhat in feather texture, and I doubt that they are even closely allied.

On the basis of juvenal characters sumichrasti, like several other species of Aimophila, is a well differentiated form with no very close allies. Of the species here considered, it is closest to humeralis, the two being much more alike as juvenals than as adults. A. ruficauda may also have its closest alliance with these two. It is more like them in juvenal plumage than any other species, and adult sumichrasti and ruficauda have similar patterns.

Similarity of juvenal characters of ruficeps and rufescens supports Ridgway's grouping of the two together.

I have noted precocious development of winter plumage in the back and scapular region of stub-tailed specimens of aestivalis, carpalis, and sumichrasti. A specimen of rufi-

cauda was too young to show this development, but older specimens of all the other species here considered indicate that they, too, develop winter plumage in the back early. The juvenal plumage is short-lived in some of these species, while in others, most of it is retained a while. In aestivalis, botterii, cassini, and sumichrasti, the postjuvenal molt is well under way by the time the rectrices are grown. In rufescens, ruficeps, mysticalis, and humeralis most of the plumage is retained until well after the flight feathers are grown. I have no data on the longevity of the plumage in carpalis and ruficauda. A. botterii, cassini, and aestivalis are migratory, and the short-lived juvenal plumage is not surprising. The short-lived condition in non-migratory sumichrasti may have taxonomic significance.

With regard to the completeness of the postjuvenal molt in Aimophila, little has been published. Phillips (1951) discussed the molts of carpalis, pointing out certain odd features, e.g., its nesting not in spring but in late summer, and its undergoing a nearly complete prenuptial molt while breeding. Phillips has recorded birds in the postjuvenal molt in September, October, and November, but, as indicated above, winter plumage develops very precociously in the back and scapular region in this species. The postjuvenal molt is incomplete, involving (usually) the body plumage and tertials but not the flight feathers. I have found no published data on the other species, except a statement by Chap-

man (1914) which is slightly misleading. After referring to the streaked underparts of nestling Aimophila, he says that "these streaks are lost at the postjuvenal molt." The statement is true but it implies that the first winter plumage is unstreaked below, and first winter Georgia specimens of aestivalis at hand are definitely streaked on the chest. The postjuvenal molt in cassini is complete (Graber, 1953).

Composite juvenal Aimophila has the head and dorsal patterns of the adult and is streaked below, though the latter feature varies greatly from species to species. The juvenal has the "mustache" pattern if the adult does, and this reflection of the adult pattern in the juvenal is rather constant throughout the Fringillidae, but in most of the other genera considered here, the species are much more alike as juvenals than as adults. There is no reason to believe that the juvenal plumage is less conservative (to change) in Aimophila than elsewhere. Since there is considerable variation in juvenals within Aimophila, certain considerations as to the evolution of the several species are in order. Either Aimophila is of polyphyletic origin, or certain species, or groups of species, have been isolated longer than have species in other genera of Fringillidae. Several Middle American species are poorly known except as museum specimens, and nomenclatural changes are certainly not advisable at this stage of our knowledge. I would, therefore, retain Aimophila as Ridgway and most other workers do. Within the group I

suggest the following linear arrangement of forms: aestivalis, botterii, cassini, carpalis, mysticalis, humeralis, ruficauda, ruficeps and rufescens. Aestivalis may be an unspecialized member of the group. Its rather narrow ecological preference may be indicative of this, as also its geographic range along the periphery of the group. I believe that Chondestes is the closest generic ally of Aimophila. In all plumages Chondestes has patterns which are characteristic of Aimophila, and the distinctive texture of its juvenal plumage indicates closeness to A. carpalis.

Amphispiza (Plate 28)

This genus contains two species, bilineata and belli. Juvenal Amphispiza has the dorsal pattern and head pattern of the adult, and is conspicuously streaked below. In bilineata the juvenal is obscurely streaked on the back and the crown is unstreaked; in belli (nominate race and nevadensis), the crown and back are conspicuously streaked. Adult bilineata is not streaked anywhere, while belli is obviously streaked on the back, sides, and flanks (the nominate race less so than nevadensis). The two species are somewhat more alike as juvenals than as adults since the throat color and pattern is the same in the juvenals, different in adults. The two species appear to be congeners, properly speaking, but they certainly are not as close as are the species of Spizella and Junco. Modern forms of both bilineata and belli are known

from the Pleistocene (La Brea), and their differentiation has apparently been of long standing (Wetmore, 1951).

Though juvenal belli (nominate race) acquires some fresh (presumably winter) feathers in the interscapular region before the rectrices are half grown, the juvenal plumage in Amphispiza is relatively long lived. This is indicated by the thoroughly worn condition of several specimens of both species I have seen. Mrs. John Whitaker of Norman, Oklahoma, kindly lent me her notes on the development of a captive juvenal Amphispiza bilineata deserticola. These indicate that the plumage was held at least a month and a half before replacement started on the chin and throat, but the molt apparently proceeded slowly and most of the juvenal plumage was held much longer.

I have found no published data on the postjuvenal or other molts in this genus. Mrs. Whitaker's captive bilineata underwent a complete postjuvenal molt but the molt of flight feathers proceeded very slowly and did not begin until about three months after the body plumage had been replaced. The wing feathers started first, and the molt of rectrices lagged by about two weeks. This may not have been a normal molt.

The appearance of the juvenal plumage in Amphispiza indicates close alliance to Spizella, and also to Junco. The long-lived nature of the plumage may be a poor taxonomic character, but it is approached by certain Spizella, notably S. passerina.

Junco (Plates 29-31)

In considering the juncos, I have followed the classification of Miller (1941), who dealt mainly with characters of the adult. I have handled specimens of vulcani, alticola, fulvescens, bairdi, phaeonotus, caniceps, oreganus, hyemalis, and aikeni, but not of insularis, which according to Howell and Cade (1954) is quite a distinct form. Ridgway (1901) has described the juvenal of insularis.

The species of Junco are much alike, with the possible exception of vulcani, which both Miller (1941), on the basis of juvenal characters in the adult, and Tordoff (1953), on the basis of palatal features, have considered a primitive form. Juvenal vulcani is more like other juvenal juncos than adult vulcani is like other adult juncos. Adult vulcani is streaked on the back, while all the other species are entirely without streaks in non-juvenal plumages. All juvenal juncos are streaked both dorsally and ventrally. J. bairdi is not heavily streaked, being unique in this respect as a junco. Both dorsally and ventrally its streaking is very fine, in places being reduced to fine spotting. Miller (1941) stated that the affinities of bairdi were with the Central American species, not with J. oreganus townsendi, its closest congener geographically. In fulvescens of Central America, the ventral streaking is somewhat reduced, and it would appear to be the closest ally of bairdi.

Besides the streaking common to juvenal juncos, some species have two narrow, but fairly distinct, wing-bars. All the species examined showed this condition to some degree, and it is a common juvenal feature in other groups also. For this reason it would seem to carry little weight as a taxonomic character. Aikeni is the only junco which has definite wing-bars in adult plumage, and, even here, it is an exceedingly variable character (Miller, 1941). Beckham (1885) recorded an adult specimen of hyemalis with white wing-bars from Maryland, and I have seen several juvenal hyemalis with this pattern rather well developed. J. aikeni shows wing-bars in the juvenal plumage, but how variable the character may be I cannot say. Wing-bars were also well developed in the juvenal alticola which I have examined.

Except for this streaking and wing-barring, juvenal juncos tend to have the same characters as the adult, species for species. With the exception of the two races of hyemalis, all the forms I have considered are readily identifiable in the juvenal plumage. I do not imply, here, that all specimens of juvenal juncos are readily identifiable, any more than are adult specimens of the genus. J. aikeni and hyemalis are much alike in juvenal plumage, and there can be little question of their close relationship, though Miller (1941) gives good reasons for considering them distinct species. On the basis of the appearance of the juvenal plumage, oreganus (I have seen specimens only of the nominate race and of

mearnsi) also appears to be closer to hyemalis than to other species of the genus. This close relationship is further indicated by the existence of a stabilized hybrid population, "Junco hyemalis cismontanus," of which oreganus and hyemalis are the parental stock (Miller, 1941). J. phaeonotus and caniceps are quite distinctive in juvenal plumage, and appear to be closer to the Central American species than to hyemalis, aikeni, or oreganus. Juvenal J. c. caniceps and J. c. dorsalis have gray-edged tertials, while the races of phaeonotus have chestnut tertials, as do alticola and fulvescens. In bairdi the tertial color is distinctive but closer to that in phaeonotus than that in caniceps.

There is considerable variation in Junco as regards the longevity of the juvenal plumage. The only juvenal aikeni I have seen, and several juvenal hyemalis, indicate that these species attain a nearly complete juvenal plumage, as do bairdi and the Central American species vulcani, alticola, and fulvescens. As in Spizella there is an early advent of winter feathers in the interscapular region. J. vulcani shows this condition but most of the juvenal plumage of this species is held until the flight feathers are full grown. The following acquire some winter feathers in the interscapular region long before the flight feathers are full grown: oreganus (nominate race and mearnsi), caniceps (nominate race and probably dorsalis), and phaeonotus (nominate race). That these are winter feathers, and not tardily devel-

oped juvenal feathers, is indicated by their uniform (unstreaked) color and firm texture. After these early winter feathers have appeared, the molt proceeds slowly. When the flight feathers are full grown, the body plumage is still largely juvenal. Throughout the genus the juvenal plumage seems to remain unmolted for a considerably longer period ventrally than dorsally. The plumage is firm and dense, especially in vulcani. The feather texture in this species is quite distinctive.

Dwight (1900) stated that the postjuvenal molt of hyemalis was incomplete, involving the body plumage and coverts but not the flight feathers. I have found no other published data on junco molts. From the appearance of caniceps (nominate race) and oreganus (the race mearnsi) specimens handled, I should say that the molt in these forms is like that in hyemalis.

As already mentioned, the Irazu Junco (vulcani) is probably the most primitive extant member of the genus. Its juvenal patterns are like those of other species. On the basis of juvenal characters, Spizella, Amphispiza, and Zonotrichia appear to be the closest allies of Junco; of these four genera I consider Junco to be most specialized in plumage characters. The four groups are similar in juvenal patterns and in the texture of the juvenal plumage.

Spizella (Plates 32 and 33)

I have examined juvenal specimens of arborea, passerina, pusilla, pallida, breweri, taverneri, and atrogularis, but not of wortheni. Bailey (1928) has briefly described the juvenal of wortheni, a moot form, considered a full species by Webster and Orr (1945), but called a race of the Field Sparrow (S. pusilla) by Burleigh and Lowery (1942).

In Spizella, as in Zonotrichia, the juvenal plumage is streaked ventrally and tends to have the head and dorsal patterns of later plumages. The amount of ventral streaking is variable, but arborea, passerina, pallida, breweri, and taverneri are always conspicuously, even profusely, streaked below. S. pusilla and atrogularis are exceedingly variable in this character; the streaking is often conspicuous in pusilla, never in atrogularis. These two species resemble each other in another respect: absence of streaking in the crown. In other species of Spizella the crown is streaked.

With the exception of breweri and passerina, the species of Spizella are readily identifiable as juvenals. Juvenal breweri and passerina differ subtly in color, breweri being grayer, less rufous, and having an indistinct post-ocular stripe. The two forms are obviously closely related. S. taverneri has been considered a race of breweri by many taxonomists, but in juvenal plumage the two forms are quite distinct (Swarth and Brooks, 1925), taverneri being much the

darker and more heavily streaked. In juvenal plumage, taverneri differs from breweri more than does breweri from passerina. Furthermore, neither intergradation between the two, nor overlapping of range, has been reported (Cowan, 1946). For these reasons I consider taverneri to be a distinct species.

Juvenal pallida is distinctive and readily identifiable since it has the head patterns of the adult, and the breast, sides, and flanks are strongly tinged with buff. S. pallida and breweri resemble each other much more closely as adults than as juvenals, and I consider pallida less closely allied to either breweri or passerina than these two are to each other.

S. arborea is the most heavily streaked species of the genus as a juvenal and some specimens resemble juvenal Zonotrichia leucophrys closely. The closest extant congeners of arborea probably are taverneri, passerina, and breweri. The juvenal plumage in Spizella tends to have the same wing-bar patterns as the adults. The post-juvenal plumages are normally unstreaked on the under parts, an exception being taverneri, first winter specimens of which are often finely streaked, especially on the flanks. This streaking probably is a primitive character, and since the range of the form is very limited, taverneri may well be a relict species.

Several species of Spizella attain a complete or nearly complete juvenal plumage. Studies by Baumgartner

(1938) on arborea, and Sutton (1935, 1937) on pusilla and passerina shed light on this matter and on the postjuvenal molt. In these three species new feathers appear in the scapular region and upper back well before the flight feathers are full grown. In passerina, these incoming feathers do not actually replace juvenal feathers. Sutton (1935) suggested that these new feathers (which appear after the rest of the juvenal body feathers are unsheathed and before the postjuvenal molt proper has begun) might be part, or possibly all, of some intermediate "postjuvenal" plumage. Baumgartner (1938) called the new feathers winter plumage. Because of their brightness and firm texture in pusilla I am inclined to believe that in that species at least, they are part of the winter plumage, but the subject certainly deserves further investigation.

The postjuvenal molt in Spizella seems to start in the upper back or scapular region and to take place rapidly in that particular area for a time, but in other parts of the body to be delayed, often until the flight feathers are full grown. In Junco, the same early influx of feathers in the interscapular region of the upper back is observable. The incoming feathers are almost certainly winter plumage, not juvenal, since they are solidly colored (unstreaked) and of a firm texture. I strongly suspect that the new back feathers in Spizella are winter plumage also. The plumage worn by a Chipping Sparrow (passerina) when its first flight feathers

are attaining full length is not precisely speaking the juvenal, but a mixture, rather, of juvenal and winter.

The juvenal plumage of passerina is complete except for the interscapular winter feathers above discussed. It is worn for some time after the flight feathers have reached full length. In arborea and pusilla the juvenal plumage is shorter-lived. Stub-tailed breweri and pallida which I have examined have shown a precocious development of winter back plumage. S. pallida probably does also; the oldest juvenals I have seen still had sheathed flight feathers. As for tavernieri, I have seen only one juvenal specimen, and it was molting though its rectrices were only about two-thirds grown. The juvenal plumage probably is short-lived in this strongly migratory species.

Dwight (1900) stated that the molt of arborea was incomplete, as in pusilla. In arborea the juvenal body plumage is replaced but the wing and tail feathers are not. In the other two species the flight feathers are retained--with the occasional exception of the median pair of rectrices in pusilla. Baumgartner (1938) and Sutton (1935) have discussed the postjuvenal molt of these species in detail. I can find no published data on the postjuvenal molt in other species of Spizella.

Immature arborea, passerina, pusilla, breweri, and pallida undergo a partial prenuptial molt in the spring (Dwight, 1900; Baumgartner, 1938; and Chapman, 1910). Accord-

ing to Chapman this molt is confined largely to the chin and throat in arborea and pusilla and to the head in passerina and breweri; but in pallida it involves also the wing coverts and tertials.

Placing Spizella between Junco and Zonotrichia seems to declare relationships properly in so far as a linear arrangement can. Spizella seems to contain three groups: (1) pusilla, wortheni, and atrogularis, which are obviously close to each other but as a group are different from the rest, which may represent an entirely different line, and which may well be the most primitive forms of the genus; (2) passerina, pallida, breweri, and taverneri, which are obviously related inter se; (3) arborea, which represents the opposite extreme from the pusilla group and best shows Spizella's affinities to Zonotrichia.

Zonotrichia (Plates 34-36)

This group of five species (albicollis, querula, coronata, leucophrys, capensis) demonstrates the conservative-to-change nature of the juvenal plumage. Juvenals are heavily streaked both ventrally and dorsally, but species-characters show in the head and back, making identification easy. Later plumages diverge considerably in the character of head pattern, but the juvenal plumage is remarkably uniform throughout the genus. The taxonomic history of the only South American species, capensis, is pertinent. Z. capensis

was long considered to belong in the monotypic genus Brachyspiza. Van Rossem (1929) pointed out that wing-tail proportions and certain habits were similar to those of Zonotrichia. Chapman (1940), in one of the few such cases I have found in the literature, used the juvenal plumage in demonstrating the true affinities of capensis to Zonotrichia. This author also pointed out that isolation of capensis from its northern congeners probably occurred during the Pleistocene. While the adult plumages have diverged considerably in the interim, the juvenal plumage is much like that of other Zonotrichia, especially leucophrys. Z. leucophrys is the most southward-ranging of the North American species and it probably is the closest ally of capensis.

As for relationships among the North American species, albicollis, the most distinctive, is one of the two species having ventral streaking in postjuvenal plumages. The other is querula. I do not consider this streaking to be, necessarily, a primitive character. Z. querula, coronata, leucophrys, and capensis are very much alike in juvenal plumage.

Uniformity within Zonotrichia is apparent in the postjuvenal, and to some extent in other, molts. In all the species but capensis the juvenal plumage is relatively short-lived, the molt beginning well before the flight feathers are full grown. Chapman (1940) indicated that the juvenal plumage of capensis probably persisted for several weeks. Speci-

mens (of several races) which I have examined have been in nearly complete juvenal plumage and have shown wear on the flight feathers, so that the plumage appears definitely to be longer-lived in this resident southern species than in the North American species, all of which are migratory.

Throughout the genus, the postjuvenal molt begins in the interscapular region of the upper back, continues with the lesser wing coverts, and proceeds with the breast and body plumage in general. Dwight (1900) and Chapman (1912, 1913, and 1940) indicated that the molt was incomplete, involving body plumage and coverts, but not the flight feathers. Law (1929) indicated that immature birds of the four northern species have an incomplete prenuptial molt in the spring involving the body plumage, the median pair of rectrices, and the tertials. Chapman (1945) found no evidence of such a molt in capensis.

Passerella (Plates 37 and 38)

Linsdale (1928), on the basis of similarity of osteological characters and of certain aspects of their natural history, suggested that differences between the Fox Sparrows (Passerella) and Song Sparrows (Melospiza) were insufficient to warrant generic distinction. He made no particular reference to juvenal characters, but these support his views, so I have followed his classification.

I have seen juvenal specimens of all the species--

iliaca, melodia, lincolni, and georgiana. Throughout the genus, except in georgiana, the juvenal is much like the adult in pattern and even in color. The juvenal plumage demonstrates the same geographic variation as that of the adult. In georgiana, however, the dorsal patterns of the juvenal are similar to those of the first winter plumage or of the winter adult, but with the crown more solidly colored, while the ventral pattern is almost identical with that in juvenals of various eastern races of melodia. Postjuvenal plumages of georgiana are only obscurely streaked ventrally. On the basis of dorsal patterns and coloration, juvenal specimens of georgiana are readily identifiable, as are juvenals of the other species, since they so closely resemble adults except in plumage texture. Most juvenal melodia which I have seen even show a pectoral spot, as do some juvenal georgiana.

Though iliaca has diverged somewhat from the others, its juvenal plumage is like that of the other species. The genus is, indeed, a uniform unit.

Sutton (1935) has pointed out that the juvenal plumage in melodia and georgiana is long-lived. Juvenal lincolni and iliaca which I have seen indicate that in these species also, most of the juvenal plumage is held for a relatively long period. It should be pointed out, however, that, as in several other fringillid genera, there is an early advent of winter feathers in the interscapular region. I have observed this condition in iliaca, georgiana, and melodia. As for

lincolni, I have seen no stub-tailed specimens.

The "molt" in question starts before the rectrices are half grown, though well after the juvenal body plumage is developed. It appears to be very limited and the incoming feathers may not actually replace juvenal feathers (Sutton, 1937). Even if some juvenal feathers are replaced, most of this plumage remains unmolted, at least until the flight feathers are full grown, and probably for some time thereafter. This is true throughout *Passerella*.

Dwight (1900) stated that in New York the juvenal plumage of *melodia* was worn for several months. Sutton's (1935) estimate was more conservative, and, I think, more accurate, but the exact longevity of this plumage in any species of *Passerella* remains to be ascertained.

Dwight (1900) discussed the postjuvenal and other molts in eastern races of all four species of the genus. Chapman (1910) discussed the postjuvenal molt of *melodia* (eastern races, presumably). I have found no published data on molts in various other races of the species of *Passerella*. Thus, so far as is known, the postjuvenal molt is incomplete in all species, but more complete in *melodia* than in the other species. In *iliaca*, *lincolni*, and *georgiana* it involves the body plumage and wing coverts but not usually the flight feathers, while in *melodia* the rectrices and tertials always, the primaries usually, and the secondaries occasionally, are replaced. In *melodia*, then, and in contrast to the other

species, the molt is nearly complete. I consider this a primitive condition. According to Dwight (1900) there is no spring molt in immature melodia or lincolni, but in iliaca there is such a molt, involving feathers of the chin, and in georgiana of the chin and crown.

On the basis of juvenal characters, the nearest ally of this genus would appear to be Zonotrichia. There is, in fact, a very close resemblance between juvenals of the two groups. Particularly is this true of Zonotrichia albicollis and Passerella melodia, which differ, actually, only in color intensity. The juvenal and immature plumages of Zonotrichia albicollis seem clearly to bridge the gap between Zonotrichia and Passerella. I mention this only to point out how close they appear to be. The similarity is not restricted to characters of the juvenal plumage, as Bendire (1889) pointed out; their eggs are also similar. I do not suggest that they be placed in the same genus, however, since this might obscure rather than clarify the relationships between the two groups of species. Furthermore, Tordoff (1954) has shown some consistent differences between the two groups in features of the skull.

Rhynchophanes and Calcarius (Plate 39)

McCown's Longspur (Rhynchophanes mccowni) was for a time joined with the other longspurs under the generic name Plectrophanes, but it has long been considered different from

them in certain ways. Tordoff (1954) recently showed that Rhynchophanes and the three species of Calcarius (lapponicus, pictus, and ornatus) have similar palatal and squamosal features of the skull, and hinted that they might all be congeneric.

As far as characters of the juvenal plumage are concerned, placing mccowni in Calcarius would not notably affect the uniformity of the genus. In plumage characters Calcarius as it now stands is not as uniform a group as many fringillid genera appear to be, but similarity of juvenal plumage within the four longspurs supports Tordoff's (1954) view. Of the four species, the two resembling each other most closely as juvenals are not two species of Calcarius but McCown's Longspur (Rhynchophanes) and the Chestnut-collared Longspur (Calcarius ornatus). These two have nearly identical scaled back patterns and decidedly similar wing patterns. Smith's Longspur (Calcarius pictus) also has a scaled back, but the pattern is not like that in either mccowni or ornatus. In other features pictus bears closer resemblance to the Lapland Longspur (C. lapponicus), though juvenal lapponicus has a streaked back pattern. That pictus may actually be close to lapponicus is indicated by the fact that pictus appears to show a transition between a scaled and a streaked back pattern, while in other patterns (head, throat, and chest streaking, and wing coloration) it is very similar to lapponicus.

If juvenal plumage patterns indicate relationships,

the linear arrangement of longspur species would be lapponicus, pictus (showing transition to the scale-backed species), ornatus, and mccowni. It is highly possible that the juvenal plumage may not be a reliable taxonomic aid in this group. Shortt (1951) suggested that a scaled back pattern in juvenals of species which inhabit prairie habitat might be an adaptive feature with real survival value, since this pattern occurs in several species of prairie birds, even in different families. In this connection the distribution of the longspurs should also be considered. All are birds of open country, but lapponicus and pictus are closely allied as regards distribution and ecology. R. mccowni and C. ornatus are also close in these respects. C. lapponicus and pictus are arctic species which inhabit tundra to a large extent, while the mccowni and ornatus are grassland species of comparatively southern regions. In view of these facts and the possibility that juvenal patterns in this group are highly adaptive, one would expect lapponicus and pictus to resemble each other and mccowni and ornatus to resemble each other, as they do. This does not mean that the relationship suggested earlier is unsound. Classification is based on adaptive features, and the longspur distributions cited are actually in keeping with the classification suggested.

If Willis's (1922) hypothesis of "age and area" operated here, Calcarius lapponicus might logically be considered the oldest member of the group since it has by far the great-

est range of the four forms. In plumage characters it appears to be the most generalized member of the group, with its streaked, sparrow-like appearance and a tail pattern less complex than in the other species (this pattern becomes increasingly complex from lapponicus to mccowni). C. pictus, which also has a broad northern range, demonstrates the transition from streaked-backed to scaled-backed juvenal, i.e., from the tundra-inhabiting to the prairie-inhabiting form. I suggest this evolution of the longspurs only as a possibility and with the realization that it does not account for the generic characters of Rhynchophanes as given by Ridgway (1901). The relatively thicker bill and relatively shorter tail of McCown's Longspur do not seem to me to be particularly strong characters.

The possibility of convergence in this group should also be mentioned. Differences in adult plumage among the four longspurs points to this possibility, as does the similarity in their apparent ecology; however, the similarity of palate does not favor a theory of convergent evolution.

The juvenal plumage in this migratory group appears to be relatively short-lived. In all the species there is an early development of winter feathers in the upper back. In mccowni the postjuvenal molt continues in other parts of the body (sides of chest) well before the rectrices are grown. In ornatus and pictus the molt also starts before the rectrices are full grown, though most of the juvenal plumage

appears to be held slightly longer than in mccowni. I have seen only stub-tailed specimens of lapponicus and have no data on longevity of the plumage in this species. As far as is known, the molt is similar also in the four longspurs.

According to Dwight (1900), the postjuvenal molt in lapponicus and ornatus is incomplete, involving the body plumage and part of the wing coverts, but not the rest of the wing nor the tail. Dwight also describes the partial prenuptial spring molt of immatures and adults in these two species. I can find no published data on the molts of pictus or mccowni.

CHAPTER V

SUMMARY

1. Characters of the juvenal plumage have not received enough emphasis in avian taxonomy.

2. A comparison of juvenal and adult specimens of most species of North American (north of Mexico) vireos, wood warblers, icterids, tanagers, and sparrows shows that throughout this great nine-primaried group the juvenal plumage is instantly distinguishable from the adult on the basis of structure or color or both.

3. The juvenal plumage provides the passerine with its first complete insulatory covering and its first flight feathers. It is, however, defective: most higher forms wear it a few days, then produce a more durable "first winter" plumage which they wear a full year.

4. Juvenal plumage is usually flimsy. The nestling's inability to produce a more durable plumage may result, in part, from hormonal imbalance. "Juvenal"-textured plumage in thyroidectomized chickens supports this view. The firm juvenal plumage of a few species evinces advanced condition.

5. In no North American sparrow is the juvenal plumage really complete by the time the first flight feathers are full grown. Winter plumage is especially precocious in the scapular region and upper back.

6. Duration of juvenal plumage varies among passerines but is constant within a given species or race. In a few species having durable juvenal plumage it is retained for weeks or even months. Evolution in this direction eliminates one molt, the juvenal plumage being held all winter. Only one passerine, the Himalayan Greenfinch (Hypacanthis spinoides), is known to do this; but certain Central and South American goldfinches may do so, since firm juvenal plumage is characteristic of goldfinches.

7. Duration of juvenal plumage varies among even species with flimsy juvenal plumage. Long-life of juvenal plumage is primitive. Most species having short-lived juvenal plumage are strongly migratory; most species having long-lived juvenal plumage are non-migratory. Two North American sparrows, Ammodramus bairdi and Ammospiza lecontei, regularly migrate in juvenal plumage.

8. Juvenal flight feathers develop largely in post-nestling life. In a few species these are fragile and "juvenal"-textured and are molted with the body plumage; but in most species they have a firm "adult" texture and are retained for a year. A complete postjuvenal molt is primitive.

9. Bright colors in juvenal sparrows are largely

restricted to fleshy parts; colors of most frequent occurrence in the plumage are buffs, browns, grays, black, and white. Juvenal eye- and foot-color is usually less bright than in the adult, evidence of the limited physiology of the nestling.

10. Juvenal plumage patterns are often strikingly different from adult patterns. The most common distinctively juvenal patterns are ventral and dorsal streaking and dorsal scaling. Species pattern characters frequently show in the head and back. Back scaling, which occurs only in prairie species, presumably has survival value; its occurrence in the juvenal but not the adult indicates greater stress in juvenal life. Juvenal patterns are probably adaptive.

11. In many families of birds there is no special juvenal pattern. In the great nine-primaried assemblage, juvenal pattern is present in groups which may be called advanced (on other bases of judgment), and lack of juvenal pattern is characteristic of more primitive groups. Juvenal patterns, though adaptive, are more conservative to change than adult patterns.

12. Marked difference in juvenal and adult patterns within the species suggest separate genic control. Juvenal life is the weak link in the post-nestling chain of development, juvenal mortality being far greater than adult, and selection during the non-breeding season comparatively less important.

13. Similarity of juvenal and adult pattern is not necessarily evidence of primitive condition; it is evidence of similarity of selective forces in juvenal and adult life, as well as of selection for concealing, not sexual, patterns.

14. Juvenal plumage characters have value in taxonomy and should be considered in classification at the level of family and below. Juvenal characters probably are of greatest value in defining the limits of monophyletic groups.

15. Juvenal characters indicate that the Leconte's Sparrow should be included in Ammospiza, and support Linsdale's (1928) classification of Passerella which includes Melospiza.

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APPENDIX

In this appendix are presented brief descriptions of the natal down and juvenal plumage of the species discussed above. Specimens examined are listed, the sex, date, locality, tail measurement, and stage of rectrix-growth being given. An asterisk beside the specimen number indicates that the specimen appears in a Plate. Statements as to colors of fleshy parts are based on label comments and the literature. Capitalized color-names are from Ridgway's "Color Standards and Color Nomenclature" (Privately published: 1912). In the special bibliographic section pertaining to juvenal plumage under each species most references are complete; where only the author, year, and page are given, see Literature Cited (above).

The following abbreviations are used: M. (Male); F. (Female); s. (sheathed rectrices); u. (unsheathed rectrices).

Specimens were borrowed from the several museums or collections listed below.

AMH	Marguerite Heydweiller Baumgartner Collection
AMNH	American Museum of Natural History
CM	Carnegie Museum
CMNH	Chicago Museum of Natural History

DMNH	Denver Museum of Natural History
GMS	George M. Sutton Collection
KU	University of Kansas Museum of Natural History
MVZ	Museum of Vertebrate Zoology, University of California.
ROMZ	Royal Ontario Museum of Zoology and Paleontology
UMMZ	University of Michigan Museum of Zoology
UOMZ	University of Oklahoma Museum of Zoology
USNM	United States National Museum

Ploceidae

Hesperiphona vespertina brooksi (Plate 1)

M., DMNH *14058, Colo., Mancos, 6 Aug., 1904; 64 mm., u.

F., DMNH *23722, Colo., Archuleta Co., 20 Aug., 1943; 66 mm., u.

Fleshy Parts: ". . . bill is dusky olive, abruptly pale green at base" (Brooks, 1934:388).

Juvenal Plumage: Forehead and nape dirty yellow (darker than Aniline Yellow), crown strongly tinged with dusky (about Raw Umber), sides of crown brighter. Back similar to crown, but scapulars brighter--dirty yellow green. Back grayer in female. Rump yellowish green. Longest upper tail coverts black, tipped with buffy. Rectrices black, narrowly white-tipped in male, but in female two lateral pairs marked conspicuously with white terminally on inner web. Primaries black, secondaries largely white in male. Secondaries in female black and white with white mainly on inner web. Inner web of tertials black in both sexes, but these largely gray in female, white in male. Coverts black, except upper greater coverts, yellow. Lores dusky, eye-ring black. Superciliary of dark yellow contrasts with darker crown. Side of head dark yellow, auriculars tinged with dusky in male,

grayish in female. Chin and throat yellowish in male, buffy yellow in female. Underparts otherwise buff colored. Crissum buffy white.

Dusky malar streaks much less prominent in male than female. Female less bright (grayer) throughout body.

Dwight (1900:169)

Ligon (1923) Auk, 40:316.

Photograph of juvenal just out of nest, showing natal down. No data on the juvenal plumage in the text.

Magee (1926) Wilson Bull., 38:170-172.

Discusses variation in juvenal and other plumages, and the postjuvenal molt. (Nominate race)

Roberts (1932) The Birds of Minnesota. Vol. II, Plate 82.

Illustration in color of juvenal. The specimen is identified as a male in the caption, but male characters are not shown.

Magee (1934) Auk, 51:386-387.

A discussion of the juvenal plumage with good descriptions pointing out sexual dimorphism in the plumage of juvenals in Michigan (nominate race).

Brooks (1939) Auk, 56:191-192.

Describes juvenal specimens representing the western race. H. v. brooksi; points out sexual dimorphism shown in this plumage.

Hesperiphona abeillei (Plate 1)

F., GMS * Mex., Tamps., Rancho Cielo, 20 July, 1948; 58 mm., u.

F., GMS *EPE1699, Mex., Tamps., Gomez Farias, 8 June, 1954; 53 mm., s.

Juvenal Plumage: There is sexual dimorphism in H. vespertina, and there may well be in this species, but I have seen no males so far as I know. Forehead and crown black, tinged with yellow green. Some crown feathers light veined, black only on edges, producing a lacy effect. Nape blackish nearest occiput, otherwise yellow green, like back. Scapulars lighter, more yellow. Rump yellowish, longest upper tail coverts blackish tinged with yellow. Rectrices black, at least outer two pairs marked with white terminally on inner web. Remiges black, innermost primaries marked on outer web with small patch of pale yellow or cream, just behind greater coverts. Tertials broadly edged with, or entirely, gray. Coverts black, except uppermost greater covert partly yellow. Lesser coverts edged with green. Lores gray, or dusky, side of head dull green-tinged buff. Chin, throat, and chest buff colored. Other underparts similar or whitish, especially on belly. Crissum buffy or buffy white.

Carpodacus purpureus purpureus (Plate 2)

F., GMS *8910, W. Va., Tucker Co., 11 July, 1939; 23 mm., s.

M., UMMZ *61673, Mich., Isle Royale, 21 Aug., 1929; 59 mm., u.

M., UMMZ 61672, Mich., Isle Royale, 21 Aug., 1929; 58 mm., u.

M., UMMZ *61674, Mich., Isle Royale, 26 Aug., 1929; 67 mm., u.

F., UMMZ 68169, Mich., Van Buren Co., 19 Sept., 1931; u.

Fleshy Parts: "Bill and feet pinkish buff, sepia-brown when older" Dwight (1900:173).

Natal down: 8910 has tufts of fuscous down on sides of crown, and on the rump.

Juvenal Plumage: No sexual dimorphism. Feathers above nostrils whitish or buffy. Forehead, crown, nape, and hindneck Mummy Brown, streaked finely with white. Superciliary line white, finely streaked with brown. Back dark (blackish) brown, streaked buffy brown, and whitish. Rump similar but paler. Upper tail coverts buffy brown, dark along shafts. Rectrices blackish, edged with greenish yellow, becoming buffy edged distally. Remiges black, tertials conspicuously edged buffy brown or buffy white. Primaries (except outer), and secondaries edged with yellowish or buffy yellow. Lesser coverts gray brown, medians and greaters blackish, edged with buffy brown. Lores brown. Superciliary white, finely streaked with brown, not extending anterior to eye. Auriculars and sub-auriculars solid Mummy Brown. Post-auriculars streaked brown and white. Underparts white,

tinged with buffy on sides and flanks. Chin and throat finely streaked with brown; chest, sides, and flanks more heavily streaked with brown. Belly and crissum white, unmarked. Leg feathers buffy white.

Carpodacus purpureus californicus (Plate 2)

M., MVZ *34265, Calif., S. Bernardino Mts., 4 Aug., 1906; 47 mm., s.

The Grinnells observed this juvenal being fed, and collected parent.

M., MVZ *27263, Calif., Fresno Co., 5300', 22 Aug., 1916; 55 mm., u.

Juvenal Plumage: Same patterns as specimens of nominate race, and similar to them, but paler throughout the dorsum, the brownish color above more nearly Saccardo's Umber in californicus. Dorsal pattern less conspicuously streaked, more uniform in California specimens. Ventrally, California finches more profusely streaked, the streaking paler, of a similar color to back.

Brewster (1878:116)

Dwight (1900:173)

Chapman (1914:24)

Forbush (1929) Birds of Massachusetts, 3:10.

Brief description of juvenal plumage.

Roberts (1932) Birds of Minnesota, 2:701.

Brief description of juvenal plumage which appears to

be in error since it does not fit this species.

Carpodacus cassini (Plate 2)

M., MVZ *32303, Calif., S. Bernardino Mts., 20 July, 1906; 25 mm., s.

F., MVZ *34302, Calif., S. Bernardino Mts., 20 July, 1906; 30 mm., s.

F., MVZ 2733, Calif., S. Jacinto Mts., 22 July, 1908; 47 mm., s.

M., MVZ 2732, Calif., S. Jacinto Mts. 8000', 30 July, 1908; 64 mm., u.

Natal down: 34302 and 34303 have tufts of fibrous, buffy white down on sides of crown (lighter than in C. purpureus).

Juvenal Plumage: No sexual dimorphism. Feathers above the nostrils white basally, tipped with dusky. Forehead and crown blackish or dark brown, finely streaked with white.(feather edgings). Nape similar to crown but with less white. Feathers of back blackish (centrally) edged with buffy brown, the pattern black and brown streaking. Rump buffy, obscurely dark streaked. Upper tail coverts brown, edged with buff. Rectrices blackish, narrowly light edged. Remiges black, secondaries and tertials edged with buff. Coverts black, medians and greaters edged with buff, forming two narrow wing bars. Lores and feathers below eye whitish; narrow post-ocular portion of superciliary white finely

streaked with brown. Auriculars, sub- and post-auriculars drab brown. Sub-auriculars dark brown at sides of chin forming a "mustache" pattern. Underparts from chin to crissum white, streaked with dark brown or blackish. Chest and sides heavily streaked, belly and crissum with least streaking, sometimes immaculate.

Older specimen notably paler on dorsum, probably from normal fading and wear. Juvenal cassini much like other Carpodacus. C. cassini and purpureus show one feature which mexicanus lacks, a partial superciliary line.

Chapman (1914) Bird-Lore, 16:107.

Duvall (1945) Condor: 205.

Brief comparison between juvenals of cassini and purpureus. Characters given do not apply to C. purpureus californicus, which is paler, not darker, than C. cassini.

Carpodacus mexicanus frontalis

M., KU 17958, New Mex., Catron Co., 9 July, 1929; 61 mm., u.

F., KU 18774, Ariz., Pima Co., 11 July, 1931; 60 mm., u.

M., DMNH 19874, Colo., Lamar, 20 June 1904; 64 mm., u.

M., DMNH 21175, Colo., Powers Co., 2 June, 1908; 43 mm., s.

F., DMNH 19886, Colo., Denver, 28 May, 1895; 52 mm., s.

F., DMNH 19889, Colo., Denver, 28 May, 1895; 54 mm., s.

? DMNH 23200, Ariz., Pinal Co., 30 Apr., 1941; 60 mm., u.

Natal down: 21175 and 19886 have tufts of whitish, rather fibrous down on sides of crown.

Juvenal Plumage: No sexual dimorphism. Feathers above nostrils white or buffy white. Crown and nape streaked drab brown and buff or buffy white (more white, and streaking more conspicuous, in worn specimens). Back feathers brown, edged with shades of buff. Rump buff colored, obscurely streaked with buffy brown. Upper tail coverts buffy brown, edged with buff. Rectrices black, edged with buff. Remiges black, edged with buff, tertials broadly so. Coverts blackish, medians and greaters conspicuously tipped with buff or buffy white forming two wing bars. Lores white or buffy white. Side of head obscurely streaked brown and buffy white. Underparts white, profusely streaked with brown, except belly. Crissum sparsely streaked, breast most heavily streaked. Leg feathers white, sparsely marked with brown.

Juvenal resembles adult female, though color of female grayer with narrower, whiter wing-bars.

Carpodacus mexicanus clementis

M., DMNH 21543 Mexico, Coronado Island, 30 Apr., 1940; 52 mm., s.

Natal down: Tufts of white down on sides of crown, conspicuously lighter than that of frontalis.

Juvenal Plumage: Same patterns as frontalis, but conspicuously darker throughout. Streaking darker brown, more

profuse. Rump coloration rich cinnamon, not merely buffy as in frontalis. Wing bars darker cinnamon buff.

Carpodacus mexicanus coccineus

F., GMS, EPE 556, Michoacan, Patzcuaro, 24 May, 1948; 61 mm., u.

Juvenal Plumage: Differs from specimens of frontalis in its darker coloration throughout, being more like juvenal clementis. Tinged with buff throughout underparts, especially on crissum. More profusely streaked ventrally with darker streaking than frontalis.

McGregor (1898) Auk, 15:265.

Brief description of nestling C. mexicanus mcgregori.

Bergtold (1913) Auk, 30:57-68.

A good discussion of nestling birds, their development and natural history (frontalis).

Dawson (1923) Birds of California, 1:215, 220.

Photographs (black and white) of juvenal House Finches.

Barley (1928:690).

Pinicola enucleator montana (Plate 3)

F., GMS *RRG 2798, Colo., Gunnison Co., 14 Aug., 1954; 94 mm., u.

M., KU *24575, Wyo., Albany Co., 28 Aug., 1946; 102 mm., u.

M., DMNH 3069, Colo., Archuleta Co., 23 Aug., 1913; 97 mm., u.

F., DMNH 3076, Colo., Archuleta Co., 23 Aug., 1913; 94 mm., u.

F., DMNH 20347, Colo., Garfield Co., 31 July, 1939;
85 mm., s.

Juvenal Plumage: Male slightly more richly colored on crown and upper tail coverts (more orange than yellow) than female. Forehead and crown dull gray-tinged yellow. Nape gray with light buffy tinge. Back plumbeus gray, feathers slightly light edged. Rump lightly-buffy-tinged gray, upper tail coverts dull yellow. Rectrices black, gray-edged. Remiges black, primaries edged with whitish or light gray. Secondaries and tertials (broadly) edged with light buffy gray. Coverts blackish, lesser coverts edged with buffy gray, medians and greaters with light buffy, forming two wing bars, the anterior darker. Lores and area above eye dull buffy yellow. Auriculars buffy-tinged gray, sub- and post-auriculars buffier. Chin and throat buffy gray. Rest of underparts dull gray, lightly buffy-tinged on crissum and legs (feathers).

Brewster (1878:116)

Dwight (1900:170)

Ridgway (1901:59, 61)

Witherby (1948, 1:92)

Describes juvenal plumage and postjuvenal molt of P. e. enucleator.

Leucosticte (tephrocotis) griseonucha (Plate 4)

M., MVZ *76637, Aleutians, Amaknak Isl., 16 July, 1901;
77 mm., s.

F., MVZ *76643, Aleutians, Amaknak Isl., 17 August, 1901; 80 mm., u.

Juvenal Plumage: No obvious sexual dimorphism. Feathers above nostrils white. Forehead, crown, and nape uniform drab brown. Feathers of back dark brown, edged with buff or buffy brown. Rump about concolor with crown. Upper tail coverts blackish, edged with buff. Remiges black, primaries and secondaries (partly) edged with pale pink. Secondaries (distally) edged with buff or buffy white. Tertials edged with buffy brown. Lesser coverts brown; medians and greaters gray, edged and tipped with buffy or buffy white. Lores brown. Side of head, concolor with crown. Chin-sides tinged with dusky brown. Chin, throat, breast, and sides uniform brown, about concolor with crown. Belly light gray. Crissum feathers gray, tipped with buff.
Ridgway (1901:73)

Leucosticte (tephrocotis) littoralis (Plate 4)

F., MVZ *39899, Brit. Columbia, Sitkine R., 23 July, 1919; 59 mm., s.

Juvenal Plumage: Like griseonucha, but with dusky crown, and dusky-tinged back. Less brown than griseonucha, though these two are brownest of the leucostictes studied.

Leucosticte tephrocotis dawsoni (Plate 4)

F., MVZ *25954, Calif., Yosemite (10800'), 22 Aug., 1915; 29 mm., s.

? MVZ *28234, Calif., Mono Co. (12800'), 6 Aug., 1916; 64 mm., s.

M., MVZ *25953, Calif., Yosemite (11500'), 21 Aug., 1915; 67 mm., u.

Natal down: 25954 has tufts of white down on sides of crown, on wings and rump. 28234 has white down on rump.

Juvenal Plumage: No marked sexual dimorphism, though flight feather edgings brighter (pinker) in males. Forehead not dusky as in L. t. littoralis and L. atrata. Dorsally, buffier (less gray) than australis with no black in back. Ventrally indistinguishable from australis. Buffier, not dark gray as atrata. Not strongly brown as L. t. littoralis and griseonucha.

Chapman (1913:366)

Grinnell (1913:77)

Described juvenal L. t. dawsoni as type specimen.

Leucosticte atrata (Plate 5)

M., USNM *228977, Wyo., Pahaska Tepee, 3 Aug., 1910; 45 mm., s.

M., USNM *228980, Wyo., Pahaska Tepee, 5 Aug., 1910; 60 mm., s.

M., USNM *228978, Wyo., Pahaska Tepee, 3 Aug., 1910; 67 mm., s.

? USNM 139132, Idaho, Salmon R. Mts., 29 Aug., 1890; 66 mm., u.

Juvenal Plumage: Males have brighter (pinker) edges on flight feathers. Feathers above nostrils white. Forehead and crown dusky gray (blackish). Occiput and nape lighter gray brown. Back feathers dusky (medially), and brown (edged). Rump uniform light buffy gray or light brown. Upper tail coverts dark gray, tipped with buff or buffy white. Remiges black, edged with pink, except tertials broadly edged with buffy brown. Coverts gray, lessers edged with buffy, medians tipped with buff and white, greaters edged with buffy or buffy brown, forming solid wing patch. Lores dusky; side of head uniform gray brown. Chin tinged with dusky. Throat, chest, and sides grayish, more or less tinged with buffy. Belly light gray. Crissum feathers whitish, edged with buff. Leg feathers white or light gray.

Leucosticte australis (Plate 5)

M., GMS, *RRG 2811, Colo., Gunnison Co., 22 Aug., 1954; 68 mm., u.

M., GMS, *RRG 2812, Colo., Gunnison Co., 22 Aug., 1954; 72 mm., u.

F., GMS, RRG 2814, Colo., Gunnison Co., 22 Aug., 1954; 67 mm., u.

F., GMS, RRG 2816, Colo., Gunnison Co., 22 Aug., 1954; 68 mm., u.

? DMNH 7100, Colo., Sunset, 3 Aug., 1917; 32 mm., s.

? DMNH 7099, Sibling to above. 30 mm., s.

? DMNH *23750 Colo., Summit Co., 28 July, 1942; 30 mm., s.

? DMNH 23751, Colo., Summit Co., 28 July, 1942; 32 mm., s.

? DMNH 23752, Colo., Summit Co., 28 July, 1942; 31 mm., s.

? DMNH 23753, Colo., Summit Co., 28 July, 1942; 32 mm., s.

Natal down: Stub-tailed specimens with tufts of white down on sides of crown, on wings and coverts, back, and rump. Also small tufts of down at the tips of rectrices.

Juvenal Plumage: Nostril feathers white. Forehead, crown, and nape pearly gray or buffy-tinged gray. Back gray, mottled with dusky, and buff or brownish. Rump uniform light buffy gray. Upper tail coverts dusky, edged with buff. Rectrices black, edged with buff. Remiges black, primaries and secondaries edged with pink (color richer in males), and narrowly tipped with white. Tertials broadly edged with buffy, as are median and greater coverts, forming wing patch, between indefinite wing bars. Lores and region about eye buffy gray, like auriculars, post- and sub-auriculars. Chin and throat gray-tinged buffy; chest buffier. Sides buffy tinged gray, belly light gray. Flanks buffy, under tail coverts dusky with buff edges.

Ridgway (1901:77-78)

Acanthis flammea fuscescens (Plate 6)

M., GMS *11700, Labrador, Goose Bay, June, 1953; 27 mm., s.

Natal down: Single tuft of gray down on side of crown.

Juvenal Plumage: Feathers above nostrils black. Forehead mottled black and whitish. Crown largely black, irregularly streaked and mottled with buffy white. Nape similar but whiter. Mid-back similar to nape but still whiter. Back and scapular region streaked black and buffy brown (no white). Rump and upper tail coverts streaked black and light buffy, the coverts slightly darker. Rectrices black, narrowly light edged. Remiges and their coverts black. Tertials edged with buff. Median and greater coverts broadly tipped with buff, forming two distinct wing bars. Lores black, Feathers about eye, whitish, but eye-ring interrupted by obscure black eye-stripe. Auriculars streaked finely, black and buffy. Chin and throat dusky, mottled with buff. Breast, sides,and flanks, buffy-tinged white profusely streaked with black. Belly white. Crissum white with few black streaks. Leg feathers light buffy.

Acanthis flammea rostrata (Plate 6)

M., GMS *11804, Baffin, Frobisher Bay, 4 Aug., 1953; 65 mm., u.

F.? GMS *11806, Baffin, Frobisher Bay, 4 Aug., 1953; 59 mm., u.

Juvenal Plumage: Females more heavily streaked on an

average but no marked sexual dimorphism. Similar to specimen of A. f. fuscescens described. Feathers above nostrils gray. Wing bars, crown, and forehead slightly lighter, but difference could be due to wear.

Dwight (1900:177)

Chapman (1914:24)

Grinnel (1943) Wilson Bull., 55:161.

Photo of juvenal at age of 11 days.

Witherby (1948, 1:69, 72).

Brief notations on juvenal plumage and postjuvenal molt in two races (rostrata, cabaret).

Acanthis hornemanni exilipes (Plate 6)

M., CM 118875, Man., Churchill, 18 July, 1936; 43 mm., s.

F., CM *109700, Southampton, Coral Inlet, 23 Aug., 1929; 56 mm., u.

M., CM *109661, Southampton, Coral Inlet, 19 Aug., 1929; 58 mm., u.

M., CM *109699, Southampton, Coral Inlet, 23 Aug., 1929; 56 mm., s.

M., CM *109711, Southampton, Coral Inlet, 24 Aug., 1929; 60 mm., u.

Juvenal Plumage: The only female much darker than males. Difference may not be entirely sexual. Feathers above nostrils whitish. Forehead, crown, nape, and mid-back profusely streaked black and white or buffy-white. Sides of back and scapular region streaked blackish and buffy. Rump

white streaked sparsely with blackish. Upper tail coverts dark brown broadly edged with buffy. Rectrices black, edged with buffy or white. Remiges black, primaries and secondaries narrowly edged and tipped with white or buffy, tertials broadly thus edged. Coverts black, medians and greaters broadly tipped with white or buffy white, forming two wing bars. Lores dusky. Eye-ring white, interrupted by dusky eye stripe. Obscure white superciliary line, streaked with dusky. Auriculars buffy, post-auriculars streaked blackish and white. Chin and throat dusky, narrowly outlined in white. Chest tinged with buffy (also sides and flanks in some specimens). Chest, sides and flanks streaked (sparsely by comparison with flammea) with dark brown or blackish. Belly white, unmarked. Crissum white, sparsely streaked with blackish.

A. hornemanni is whiter, less heavily streaked in all parts than flammea (dorsally, flammea shows practically no white, the light colors being buffy for the most part). A. hornemanni has buffy auriculars with little dark streaking, while flammea has auriculars conspicuously streaked auriculars.

Forbush (1929) Birds of Massachusetts. 3:19.

Brief description of juvenal plumage.

Witherby (1948, 1:74).

Brief description of juvenal.

Spinus tristis (Plate 7)

M., KU #8526, Kans., Republic Co., 11 Aug., 1911; u.

M., DMNH 6387, Mich., Ypsilanti, 4 Sept., 1913; 44 mm., u.

F., DMNH 6389, Mich., Ypsilanti, 4 Sept., 1913; 47 mm., u.

F., DMNH #1719, Colo., Wray Co., 23 Sept., 1910; u.

M., DMNH 23996, Colo., Conejos Co., 1 Oct., 1943; u.

F., DMNH 22079, Colo., Baca Co., 21 Nov., 1939; u.

M., DMNH 1721, Colo., Jefferson Co., 22 Oct., 1909; u.

Fleshy Parts: "Bill and feet pinkish buff," Dwight (1900:170).

Natal down: ". . . light grayish," Walkinshaw (1938: 12).

Juvenal Plumage: Males tend to be more richly colored throughout. Females lack distinct white patches in tail. Colorado specimens slightly paler than Michigan specimens. Feathers above nostrils white. Forehead tinged yellowish. Upper parts from crown to rump cinnamon or cinnamon brown. Rump lighter, upper tail coverts light buffy or buffy yellow. Rectrices black, edged with light gray, marked with white terminally. Remiges black, primaries and secondaries tipped with white. Tertials edged with cinnamon, as are secondaries, terminally, forming wing patch behind wing-bars. Coverts black, edged with cinnamon; medians and greaters broadly edged forming two wing bars. Lores gray, eye-ring white. Superciliary lighter than crown. Side of the head about concolor with brown. Chin and throat pale yellow. Other under-

parts (except crissum) pale buff, tinged with cinnamon on chest, sides, and flanks. Crissum whitish. Leg feathers white.

Dwight (1900:179)

____. (1902:152-153)

Good discussion of variation in juvenal plumage of two races (tristis and salicamans). Greater individual variation, than geographic, is exhibited.

Chapman (1910:142).

Gross (1938) Bird-Lore, 40:255-257.

Data on development of juvenal plumage. Photo of 14-day-old juvenal.

Walkinshaw (1938) Jack-Pine Warbler, 16:12-15.

Good discussion of development of nestling goldfinches, with data on size and weight increase, and plumage.

Spinus psaltria (Plate 7)

M?, KU #120 New Mex., No date, 40 mm., u.

? DMNH #3936, Colo., Denver, 28 July, 1914; 19 mm., s.

? DMNH 3936, Colo., Denver, 28 July, 1914; 18 mm., s.

F., DMNH 4160, Colo., Jefferson Co., 12 Oct., 1914; 39 mm., u.

F., DMNH 4155, Colo., Jefferson Co., 12 Oct., 1914; 40 mm., u.

F., DMNH 4154, Colo., Jefferson Co., 12 Oct., 1914; 42 mm., u.

F., DMNH 4156, Colo., Jefferson Co., 12 Oct., 1914; 43 mm., u.

Juvenal Plumage: Juvenal male has more white in tail than does female. Feathers above nostrils yellow. Upper parts from forehead to rump light olive (yellowish olive in more worn and faded specimens). Back slightly darker than crown, with faint suggestion of streaking. Upper tail coverts yellowish. Rectrices black, edged with yellowish white, the outermost pair (at least) with sub-terminal white patch, on inner web (especially). Remiges black, primaries narrowly light-edged. Secondaries and tertials edged distally with buffy yellow, forming definite patch behind wing bars. Tertials tipped with white. Median and greater coverts tipped with buffy, forming two wing bars. Lores yellowish, side of head light yellowish olive (lighter than crown, darker than underparts). Underparts light yellow, tinged with buffy on chest, sides and flanks. Leg feathers whitish.

Ridgway (1901:114, 117)

Describes juvenal plumage of nominate race; indicates that S. arizonae and S. p. mexicanus are similar.

Dawson (1923) Birds of California, 1:195.

Photo (black and white) of stub-tailed juvenal.

Spinus lawrencei (Plate 7)

F., MVZ #34769, Calif., S. Bernardino, 26 July, 1907; 15 mm., s.

M., MVZ #34767, Calif., S. Bernardino, 14 July, 1906; 49 mm., u.

Natal down: 34769 has tufts of whitish down on sides of crown, on nape and rump.

Juvenal Plumage: Males have more white in tail; Chapman (1910:197). Feathers above nostrils gray or whitish (older specimen). Upper parts uniform drab gray brown (light buffy gray in older specimen). Rectrices black, edged with gray; three outermost pairs (at least) with sub-terminal patch of white on inner web. Remiges black, primaries, secondaries, and outermost tertials partially edged with yellow. Tertials broadly edged with buff or whitish. Lesser coverts gray, the rest blackish. Median coverts broadly tipped with buff or white, broadly tipped with yellow or yellow and white. Lores, side of head, chin, and throat buffy or buffy buffy gray. Chest, sides, and flanks tinged buffy or buffy gray. Chest obscurely streaked with cinnamon or buffy gray. Belly and leg feathers white. Crissum white or buffy white.

Younger specimen more richly colored throughout, especially on the back; wing markings buffier. Difference probably due to normal wear (not sexual).

Ridgway (1901:122)

Chapman (1910) Bird-Lore, 12:197.

Data on juvenal plumage and postjuvenal molt. Does not mention of streaked ventral pattern.

Dawson (1923) Birds of California, 1:197.

Brief description of plumage.

Spinus notatus (Plate 7)

F?, GMS, *EPE 1302, Mex., Michoacan, 30 Aug., 1950;
40 mm., u.

Juvenal Plumage: Feathers above nostrils, and forehead, yellowish. Upper parts light olive green (Citrine), crown and rump paler than back. Suggestion of dark streaking throughout. Upper tail coverts blackish, broadly edged with olive green. Rectrices black, edged with yellow, except distally. Remiges black, partially edged with bright yellow (not distally), forming a long yellow wing patch on primaries continuous with smaller patch on secondaries, behind coverts. Yellow patch not as restricted as in adults. Tertials edged with yellow green, tipped with whitish. Coverts black, lessers edged with yellow green; greaters tipped with buff. Lores and auriculars gray, post- and sub-auriculars yellow. Underparts light yellow, tinged with buff on chest, sides, and flanks. Crissum marked indistinctly with dusky, in center of longest feathers. In ventral aspect, rectrices show yellow on both inner and outer webs.

Only yellow bellied Spinus (of species studied) with large yellow wing patch and conspicuously yellow-edged rectrices. Wing pattern very different in two.
Ridgway (1901:102)

Description may actually apply to winter plumage or specimen in postjuvenal molt. Juvenal wing actually shows more, not less, yellow than that of adult. Mentions pattern

of obscure streaking on crown and undertail coverts.

Spinus atriceps (Plate 7)

M., CMNH * Mex., Chiapas, Porvenir, 10 July, 1941; 45 mm., u.
F., AMNH *397802, Guatemala, Tecpam, 10 Aug., 1926; u.

Juvenal Plumage: Forehead, crown, and back olive green streaked with black, the streaking finer on crown and broader on back. Rump streaked broadly, black and yellow. Longest upper tail coverts black, broadly edged with olive green. Rectrices black, edged with green, except distally. Remiges black, partially edged with bright yellow, forming a yellow patch behind coverts (pattern as in S. pinus). Tertials edged with yellow or whitish, tipped with white. Coverts black, lessers edged with greenish; medians and greaters broadly edged with yellow, forming two wing bars. Lores gray, eye-ring light. Auriculars gray, or yellowish streaked with gray. Underparts light yellow, streaked with black. Yellow brightest on crissum, and streaking heaviest on breast, sides, flanks, and crissum

Much like juvenal S. pinus. Patterns in the two nearly identical, but wing-bars of atriceps more distinct, and dorsal streaking finer. Coloration (especially dorsum) different, olive green in atriceps, and brownish in pinus. Ventrally, atriceps more strongly yellow. Measurements of full grown juvenals indicative of identity. Mexican race of pinus large, with longer wing and tail than those of atriceps.

Ridgway (1901:101)

Description under heading "Younger," apparently of a specimen in postjuvenal molt.

Spinus pinus (Plate 7)

M., DMNH 3469, Colo., Conejos Co., 28 July, 1913; 48 mm., u.

M., DMNH 1700, Colo., Routt Co., 3 Oct., 1911; 44 mm., u.

M., DMNH 5272, Colo., Jefferson Co., 16 Aug., 1916.

F?, KU #27775, Wyo., Fremont Co., 19 July, 1949; 41 mm., s.

Juvenal Plumage: No sexual dimorphism. Feathers above nostrils buffy white. Forehead, crown, and nape finely streaked black on buffy brown. Back similarly colored but with streaking broad. Rump light buffy yellow, broadly streaked with black. Upper tail coverts black along the shaft, broadly edged with buff or buffy yellow. Rectrices black, edged (except distally) with bright yellow. Remiges black, partially edged (except outermost) with bright yellow, forming yellow patch behind the coverts (similar to adult). Tertials edged with buff or yellowish buff. Coverts black, edged with buffy or yellowish buff. Median and greater coverts broadly edged, forming two wing bars. Auriculars buffy, streaked with dark brown. Chin and throat whitish. Other underparts tinged pale yellow, profusely streaked with blackish. Crissum more strongly yellow.

Brewster (1878:117)

Dwight (1900:180)

Ridgway (1901:98)

Forbush (1929) Birds of Massachusetts, 3:29-30.

Brief description of juvenal plumage and postjuvenal molt.

Loxia curvirostre benti (Plate 8)

? DMNH 26820, Colo., Castle Rock, 22 Sept., 1953; 24 mm., s.

? DMNH *26819, Colo., Castle Rock, 22 Sept., 1953; 26 mm., s.

M., DMNH 25731, Colo., Sedalia, 15 May, 1948; 33 mm., s.

? DMNH 25372, Colo., Sedalia, 15 May, 1948; 32 mm., s.

18 additional specimens DMNH and KU, including both sexes. u.

Fleshy Parts: "Bill and feet olive-gray, black when older." (Dwight, 1900:174.) Bill and gape "conspicuously yellow" in very young birds (Munro, 1919:60).

Natal down: "Dark gray." (Bailey, 1953:51)

Juvenal Plumage: No sexual dimorphism. Feathers above nostrils white. Forehead and crown black, streaked finely with buffy white. Nape streaked, black and white. Back feathers black, edged with yellow. Scapulars black. Older, more worn specimens have more definitely streaked backs. Rump similar to back, but with more yellow. Longer upper tail coverts black, narrowly edged with yellow. Rectrices black. Remiges and their coverts black. Remiges

narrowly light-edged. Lesser coverts edged with yellow faded in older juvenals. Median and greater coverts narrowly tipped with buff. Lores light gray, eye-ring whitish. Auriculars dusky, finely white-streaked. Sub- and post-auriculars streaked black and white. Underparts streaked, blackish and buffy yellow, or buffy white (depending on wear). Sides heavily dark-streaked, and strongly yellow-tinged. Belly least heavily streaked, whitish. Crissum feathers black, broadly edged with white, or buffy. Leg feathers gray.

Loxia curvirostre stricklandi (Plate 8)

Two specimens from Mexico in Sutton collection, *PSM 239 and *247 (rectrices unsheathed) have same patterns and similar colors as L. c. benti.

Wear affects colors considerably and also increases streaking effect.

Brewster (1878:117)

Dwight (1900:174)

Roberts (1932) Birds of Minnesota, 2: Plate 82.

Color plate showing stub-tailed juvenal.

McCabe and McCabe (1933) Condor, 35:136-147.

Discuss longevity of juvenal plumage.

Griscom (1937:114-115)

Discussion of phylogeny.

Pough (1946) Audubon Bird Guide. Eastern Land Birds.

Plate 39.

Color plate of juvenal.

Witherby (1948, 1:96-97)

Discussion of down, juvenal plumage, and molts. Indicates there is slight sexual dimorphism in juvenal plumage. (L. c. curvirostre and L. c. scotica)

Tordoff (1952) Condor, 54:200-201.

On postjuvenal molt.

Bailey, Niedrach, and Bailey (1953) Denver Mus. Nat. Hist. Pictorial No. 9.

Numerous excellent photographs showing nestlings and early development of juvenal plumage. Discussion--pages 51-55.

Loxia leucoptera (Plate 9)

M., CM 30383, Ont., Moose Factory, 30 June, 1908; u.
F., CM *30385, Ont., Moose Factory, 30 June, 1908;
F., CM *30382, Ont., Moose Factory, 30 June, 1908;
M., CM *40414, Quebec, James Bay, 19 July, 1912;
F., CM 40085, Quebec, James Bay, 18 July, 1912;
F., CM 50461, Canada, James Bay, 11 Sept., 1915;
F., CM 50518, Canada, James Bay, 20 Sept., 1915;
? CM 102046, MacKenzie, Great Slave L., 15 July, 1927;

Juvenal Plumage: No sexual dimorphism. Feathers above nostrils white. Forehead, crown, and nape profusely streaked black and buff (black and white in more worn speci-

mens). Back streaked black and buffy yellow. Scapulars largely black, edged buffy yellow. Rump light buffy yellow, streaked (more finely than back) with black. Longest upper tail coverts black, edged with buffy yellow. Rectrices black, edged finely with yellow or white. Remiges black, primaries edged with whitish, upper secondaries with yellow, distally. Tertials conspicuously tipped with white. Lesser coverts narrowly edged with buffy yellow. Median and greater coverts broadly tipped with white, forming two distinct wing bars. Lores light gray. Side of head (including auriculars) streaked finely black, and buff or buffy white. Underparts profusely streaked black on buff or buffy white (in more worn specimens). Streaking lightest on belly. Undertail coverts black, broadly edged with buff or white. In ventral aspect rectrices gray, narrowly light tipped in a few specimens.

Dwight (1900:176)

Chapman (1912:48)

Roberts (1932) Birds of Minnesota, 2:699 and Plate 82.

Brief description of juvenal plumage, and colored plate of stub-tailed juvenal, though with colors insufficiently brown.

Witherby (1948, 1:101-102)

Brief--on juvenal plumage and molts.

Fringillidae

Spiza americana (Plate 9)

F., KU *15091, Kans. Anderson Co., 25 June, 1925;
25 mm., s.

M., KU *10235, Kans., Montgomery Co., 31 July, 1915;
38 mm., s.

Natal down: Pure white. (Gross, 1921:170-171, Plates opposite pp. 163, 166, and 167.)

Juvenal Plumage: No sexual dimorphism. Forehead, crown, and nape tan or buffy brown. Laterally, crown marked with dark brown. Feathers of back blackish, edged with buff. Rump uniform buff. Upper tail coverts darker (brown), with shaft blackish. Rectrices blackish with light edgings, and acuminate. Remiges and coverts blackish, tertials and coverts edged with buff. Median and greater coverts broadly tipped with buff forming two distinct wing bars. Superciliary line (lores to nape) light buff. Auricular region buff, subauriculars, chin, and throat buffy-white. Underparts, except belly, buffy (darkest on breast). Belly buffy white. Underparts unmarked.

Brewster (1878:122)

Dwight (1900:216-217)

Chapman (1911:89)

Points out similarity of juvenals of Spiza and the

House Sparrow (Passer domesticus).

Gross (1921) Auk, 38:171-183.

Excellent discussion of down and juvenal plumage and their development, and also of postjuvenal molt. Black and white photos opposite pages 163, 166, 170, 174, and 182.

Forbush (1929) Birds of Massachusetts, p. 122.

Description in error, since juvenal lacks ventral streaking.

Richmondena cardinalis (Plate 10)

F., GMS *9329, W. Va., Nicholas Co., 13 July, 1940;
13 mm., s.

M., UOMZ *1354, Okla., Marshall Co., 3 July, 1954;
97 mm., u.

Fleshy Parts: Bill olive green in 9329. "Bill and feet pinkish buff assuming when dry a dusky clay-color." (Dwight, 1900:208)

Natal down: "Mouse-gray" (Dwight, 1900:208).

Juvenal Plumage: No sexual dimorphism. Forehead, crown, and nape light brown (Saccardo's Umber). Crest not apparent in nestlings until after they leave nest; not well developed for about two weeks. Crest feathers red, tipped with light brown. Back and rump brown (Sepia). Upper tail coverts light brown, tinted lightly with rose. Rectrices red (Madder Brown). Remiges gray, edged with reddish, except distally. Wing coverts gray, edged with rose. Lores dusky

(naked in nestling). Side of head about concolor with crown (not crest). Side of head, and chin largely naked in very young juvenals. Chin and throat whitish or buffy white, tinged with gray at sides. Chest, sides, flanks, and crissum buffy or buffy gray. Belly whitish or buffy white. Leg feathers buffy.

Dwight (1900:208)

Sutton (1935:14-15)

Plate I, opposite p. 8, of 14-day-old juvenal.

____. (1941:161-168, 270-278)

Illustrations (black and white) p. 162, 165, 167, and 272 (series showing development of crest).

Good discussions of juvenal plumage and its development.

Richmondena phoenicea (Plate 10)

F., AMNH *73363, Venezuela, Cumana, 11 Aug., 1896; 70 mm., s.

M., AMNH *515551, Venezuela, Cumana, no date, u.

Juvenal Plumage: Body plumage in male more richly buffy, less gray. Rectrices in male about Brick Red, not dull as in female. Male with secondaries and primaries red, these largely gray in female. Upper parts drab Grayish Olive, becoming tinged with buffy brown posteriorly. Upper tail coverts buffy brown. Crest red (darker than Dragon's-blood Red). Rectrices about Madder Brown (female), edged

with Olive Gray. Remiges gray, edged with buff, and marked with pink near the primary coverts (female). (In male primaries and secondaries about Dragon's-blood Red.) Coverts gray; lessers, medians, and greaters narrowly edged with buff. Lores dusky, feathers about eye silvery gray. Side of head light buffy. Chin and throat whitish. Other underparts light buffy, lightest on belly, darkest on breast and crissum.

Though colors are grayer, this species very like North American cardinals in every respect.

Pyrrhuloxia sinuata (Plate 10)

M?, UMMZ *86329, Texas, Brewster Co., 5 June, 1932;
27 mm., s.

F., UMMZ *86321, Texas, Brewster Co., 4 June, 1932;
64 mm., s.

Fleshy Parts: Bill ". . . pale horn on top and base," and ". . . yellowish around edges." Feet "lavender-gray" (colors in stub-tailed juvenal female). (Personal unpublished notes of Mrs. John Whitaker.)

Juvenal Plumage: No marked sexual dimorphism though Mrs. Whitaker's notes indicate that some juvenal males show pink in undertail coverts. Forehead, crown, and nape buffy gray (buffier than Mouse Gray). Older specimen with several long, red (Madder Brown) crest feathers. Back similar to nape but darker. Rump and upper tail coverts about concolor

with nape. Rectrices Maroon, the median pair blackish (especially distally). All are tipped with grayish. Remiges dark gray, primaries (except outer) and secondaries edged (except distally) with red (about Madder Brown). Tertials and wing coverts about Mouse Gray, narrowly tipped with buff; coverts (especially primary coverts) lightly tinged with red. Underwing coverts at bend of wing pink. Side of head buffy gray (concolor with crown). Chin, throat, and belly buffy white (nearest Warm Buff). Chest, sides, flanks, and crissum buffy or buffy gray (darkest on chest). Leg feathers buffy, tinged with pink.

Brewster (1878:122)

Ridgway (1901:626)

W. Miller (1913:172)

Brief description of juvenal plumage and postjuvenal molt.

Mrs. John Whitaker, Norman, Oklahoma.

Unpublished notes contain good discussion of juvenal plumage and its development.

Guiraca cerulea (Plate 11)

F., GMS *11167, Okla., Marshall Co., 30 July, 1951; 11 mm., s.

F., UOMZ *1235, Okla., Marshall Co., 21 June, 1954; 48 mm., s.

? DMNH 4788, Colo., Yuma Co., 24 Aug., 1915; 51 mm., s.

M., DMNH 2090, Colo., Wray Co., 21 Aug., 1911; s.

F., DMNH 2089, Colo., Wray Co., 21 Aug., 1911; s.

F., DMNH 2091, Colo., Wray Co., 21 Aug., 1911; s.

Fleshy Parts: 11167 had dark brown eyes. "Bill and feet dusky pinkish buff becoming darker." (Dwight, 1900:210)

Natal down: 11167 has tufts of pale buffy brown down on rump. 2089 with tufts of dark brown down on nape.

Juvenal Plumage: No sexual dimorphism. Forehead, crown, and nape rich brown (about Prout's or Mummy Brown). Back similarly colored but mottled gray (feather centers), and lighter brown (edgings). Rump (except in very young specimens) paler than back, buffy or buffy brown. Longest upper tail coverts dusky, tipped with buff. Rectrices black, narrowly tipped with buff. Remiges and their coverts black. Tertials edged with buff. Median and greater coverts broadly tipped with buff, forming two wing-bars. Lesser coverts narrowly buff-tipped. Lores buffy white. Auriculars dull brown; sub-auriculars, sides of chin and throat buffy. Chin pale buffy white. Underparts, otherwise, buffy, darkest on chest.

Rich color of younger birds fades rapidly with wear.

Dwight (1900:210)

Ridgway (1901:608)

Chapman (1911:202)

Pheucticus ludovicianus (Plate 12)

F., GMS *10385, Mich., Ann Arbor, 16 June, 1948; 28 mm., s.

M., UMMZ 42646, Mich,, Ann Arbor, 15 June, 1912; 18 mm., s.

M., UMMZ #35465, Iowa., Palo Alto, 26 July, 1907; 25 mm., s. M., DMNH 7213, Mich., Ypsilanti, 20 July, 1914; 72 mm., s.

Fleshy Parts: Bill of 10385 light pinkish brown; eyes dark brown; feet bluish gray.

Natal down: 10385 and 42646 with tufts of nearly pure white down on sides of crown and nape, and rump.

Juvenal Plumage: Males slightly darker throughout dorsum. Marked sexual dimorphism exhibited in feathers at edge of bend of wing. In male these are bright pinkish red, in female pale yellow. Forehead and crown black. Crown with broad buffy white median stripe (extends to nape) and white superciliary stripe. Nape white medially, black laterally. Back mottled brown, white and blackish. Rump buffy white. Upper tail coverts brown medially, buff-edged. Rectrices dull brown, lightly white-tipped on inner web. Remiges dark gray or blackish, primaries and secondaries unmarked. Tertials brownish with narrow buff-edgings, each with buffy white terminal spot. Coverts grayish brown, median and greater coverts tipped with buffy white, forming two distinct wing-bars. Lores black and white. Broad white superciliary (narrowest anterior to eye) extends to nape. Auriculars brown, post-auriculars blackish anteriorly, white posteriorly. Sub-auriculars white. Definite dark cheek patch bordered by white. Underparts white. Some specimens with few small black marks at side of lower throat and upper breast. Legs white marked with dark brown laterally.

Dwight (1900:208-209)

Chapman (1912:162)

Roberts (1932) The Birds of Minnesota, 2:703. Plate 79.

Description of juvenal plumage. Color plate of juvenal male in error in that it shows underparts strongly washed with buff (actually, nearly pure white).

Ivor (1944) Wilson Bull., 56:97.

Good photo (black and white) of two twelve-day-old juvenals.

Pheucticus melanocephalus (Plate 12)

? DMNH 5241, Colo., Denver, 6 Aug., 1916; 52 mm., s.

? DMNH 5242, Colo., Denver, 6 Aug., 1916; 49 mm., s.

M., KU *17609, New Mex., Catron Co., 9 July, 1929; 48 mm., s.

M., GMS *DW 507, Mexico, D. F., 23 July, 1942; 68 mm., s.

(This specimen does not differ from the U. S. birds.)

Natal down: White down on rump of DW 507.

Juvenal Plumage: No sexual dimorphism. Forehead and crown black, with broad median stripe (white on forehead, buffy posteriorly). Superciliary white. Nape black (anteriorly) and buffy white (posteriorly). Back streaked, buff, white, and black. Rump largely buffy with few black marks. Upper tail coverts brownish, broadly edged with buff. Rectrices gray, lightly edged with greenish; outer three pairs light tipped on inner web. Remiges blackish, narrowly edged with white on primaries, with greenish on secondaries and

tertials. Tertials with large white spot (terminally) on outer web. Coverts concolor with remiges. White and buff edging on median and greater coverts form two distinct wing bars. Feathers at edge of bend of wing light yellow, streaked with black. Broad white superciliary extends to nape. Feathers about eye white, interrupted by dark eye-line. Auriculars and post-auriculars black, sub-auriculars white, forming distinct cheek patch. Chin white. Chest, sides, and crissum buffy. Belly nearly white. Chest and sides finely streaked with black.

Brewster (1879:41)

Ridgway (1901:618)

Finley (1904) Condor, 6:145-148.

Good photos (black and white) of stub-tailed juvenals.

Chapman (1912:162)

Michener and Michener (1951:94-96)

Discuss possible sexual dimorphism in juvenal; also postjuvenal molt.

Pheucticus chrysopeplus (Plate 12)

Note: Specimen tentatively identified as this species; it may prove to be P. aureo-ventris.

? AMNH *513917, Ecuador, 1886; s.

Juvenal Plumage: Median crown stripe yellow, mottled with black. Feathers of forehead and crown black, edged with yellow. Nape yellow, finely mottled and streaked with black.

Back broadly streaked, black and yellow. Rump dull yellow, obscurely marked with black. Upper tail coverts buffy, marked with black along shaft. Rectrices olive gray. Remiges gray, secondaries and tertials edged with dull yellow. Tertials with terminal spot of white on outer web. Lesser coverts yellow, marked with black. Median and greater coverts gray, broadly tipped with yellow forming two wing-bars. Conspicuous broad, yellow superciliary. Auriculars mottled yellow and black, sub-auriculars largely yellow. Chin whitish. Other underparts yellow (brightest on breast and belly). Throat and chest streaked finely with black. Crissum tinged with yellow, unmarked.

Passerina leclancheri (Plate 13)

M., GMS *EPE 1529, Mex., Oaxaca, 12 Aug., 1952; 53 mm., u.
M., CMNH 102722, Mex., Michoacan, 24 Aug., 1941; 51 mm., u.

Juvenal Plumage: Upperparts light gray-green (Citrine Drab). Back slightly brighter than other parts. Rectrices light blue. Remiges gray, primaries and secondaries edged with light blue, tertials with Citrine Drab. Wing coverts gray, very narrowly edged with buffy. Side of head about concolor with crown. Sub-auriculars, chin, and throat pale yellow. Chest and its sides gray (about Olive-Gray). Belly and crissum pale yellow or yellowish white (crissum brightest).

Passerina ciris (Plate 13)

F., GMS *12127, Okla., Marshall Co., 20 June, 1954; 15 mm., s.

F., GMS *12127, Okla., Marshall Co., 20 June, 1954; 11 mm., s.

M., GMS 12209, Okla., Marshall Co., 2 Aug., 1954 52 mm., u.

Fleshy Parts: "Bill: umber brown, the upper mandible darker." (Dwight, 1900:215)

Natal down: 12127 with tufts of light gray down on sides of crown.

Juvenal Plumage: Wings and tail duller in females, according to Dwight (1900:215). Forehead, crown and back gray (Mouse Gray), the color fairly uniform throughout, becoming tinged with buffy on lower back. Rump and upper tail coverts more richly buff-tinged, less gray. Rectrices appear gray in stub-tailed birds but tinged and broadly edged with green when grown. Remiges dark gray, edged (except distally) with pale green. Tertials edged with green-tinged buff. Coverts gray, medians and greaters edged narrowly with buffy white. Lores light gray, eye-ring cream colored. Side of head, chin, and throat pale buffy gray. Breast largely light gray, buffy in center. Sides and flanks tinged with buff. Belly, crissum, and leg feathers pale buffy yellow, or rich cream.

Juvenal ciris much like juvenal leclancheri. Neither ciris nor leclancheri at all streaked; both have same gray breast coloration and contrasting light belly, and light throat. Obvious difference: leclancheri has light yellow

chin and throat; no yellow in ciris.

Dwight (1900:215)

Chapman (1911:250)

Storer (1951:3)

Brief discussion of postjuvenal molt.

Passerina versicolor (Plate 13)

M., AMNH *84507, Tex., Rio Grande, 15 July, 1880; 35 mm., s.

F., AMNH *5087, Tex., Marfa, 16 July, 1883; 45 mm., s.

Juvenal Plumage: Description taken from Ridgway (1901:591), since specimens I have seen are quite old and may be discolored. "Young in first plumage. . . . Above grayish brown or drab (less olivaceous than in summer female), the edges of rectrices and primaries dull glaucous, or inclining to that color; middle and greater wing-coverts tipped with pale brownish buff, forming to indistinct narrow bands; under parts dull whitish medially, pale brownish laterally and across chest."

Plumage texture and patterns identical to those in ciris, but colors (in versicolor) browner throughout, especially dorsally.

Passerina rositae

F., USNM * 144206, Mex., Oaxaca, 30 July, 1895; 50 mm., u.

Juvenal Plumage: Forehead, crown and back uniform dull brown (about Olive-Brown). Rump and upper tail coverts grayer (about Mouse Gray). Rectrices light blue. Remiges

dull gray, primaries and secondaries edged with greenish gray, tertials with buffy brown. Coverts light gray, medians and greaters narrowly edged with buff. Lores gray brown, side of head concolor with crown (Olive-Brown). Chin whitish or buffy white, throat about Buffy Brown. Jugulum and upper part of breast drab gray-brown (darker than Drab). Posteriorly, chest and its sides, and upper belly whitish cream, streaked with drab gray-brown. Underparts (including crissum) otherwise unmarked, rich cream.

Ridgway (1901:590)

Passerina amoena (Plate 13)

M., KU *31529, Colo., Mesa Co., 29 June, 1954; 32 mm., s.
F?, KU 18076, New Mex., Eddy Co., 22 July 1930; 55 mm., u.
F., GMS 1811, Kans., Morton Co., 4 Sept., 1952; 54 mm., u.
F., GMS 1812, Kans., Morton Co., 4 Sept., 1952; 54 mm., u.

Juvenal Plumage: No sexual dimorphism. Forehead gray brown. Back grayer, almost plumbeous gray, tinged with brownish. Crown and nape gray brown. Rump uniform buff. Upper tail coverts dark gray. Tail largely blackish, though lateral rectrices slate gray. Remiges and coverts blackish. Tertials edged with buff. Two distinct, buffy white wing bars of median and greater coverts. Lores light gray. Light buffy above eye. Auriculars buffy brown. Sub-auriculars, chin, and throat buffy white. Breast, sides, flanks, and crissum buff colored. Belly white. Breast, upper belly,

sides, and flanks streaked with dusky (dark gray). Crissum uniform buffy, unstreaked.

Much like cyanea. It differs from cyanea in being grayer (less brown) on back, in having whiter wing bars and buffier underparts. It is highly possible that some specimens could not be placed as to species without locality data.
Ridgway (1901:535)
Chapman (1911:249)

Passerina cyanea (Plate 13)

M., GMS *WM 775, W. Va., Preston Co., 6 July, 1940; 30 mm., s. F., GMS 6595, W. Va., Brooke Co., 27 Aug., 1935; 46 mm., u.

Fleshy Parts: "Bill and feet pinkish buff, the former becoming dusky, the latter dull black with age." (Dwight, 1900:211)

Natal Down: "Brownish mouse-gray." (Dwight, 1900: 211)

Juvenal Plumage: No sexual dimorphism. Forehead, crown, and nape light grayish brown (about Saccardo's Umber). Back more richly brown-colored (about Brussels Brown). Crown and back obscurely streaked with light and dark shades. Rump and upper tail coverts light buffy brown. Rectrices uniform slate gray. Remiges blackish, tertials edged with buffy brown. Greater coverts edged with cinnamon, tipped with buffy white; median coverts also tipped with buffy white, or buffy, forming two wing bars. Obscure light buffy

line over eye. Lores whitish or light gray. Eye-ring and feathers about eye buffy as is side of head. Chin and throat white. Chest, sides, flanks, and crissum more or less tinged with buff and finely streaked with brown (most heavily on the breast). Belly whitish, crissum buffy white, both unmarked. Leg feathers buffy.

Brewster (1878:122)

Dwight (1900:211-212)

Chapman (1911:202)

Forbush (1929) Birds of Massachusetts, 3:119.

Brief description. Statement, "Young males often show traces of blue," in error, as applied to juvenal plumage.

Sutton (1935:15-17)

Color Plate II, opp. p. 9, of 15-to-16-day-old juvenal. Discussion of development of juvenal plumage.

Plectrophenax nivalis (Plate 14)

? GMS 11759, Baffin, Frobisher, 16 July, 1953; 9 mm., s.

F., GMS 11737, Baffin, Frobisher, 1 July, 1953; 15 mm., s.

M., GMS 11758, Baffin, Frobisher, 16 July, 1953; 47 mm., s.

F., GMS *11757, Baffin, Frobisher, 16 July, 1953; 59 mm., s.

F., GMS *11800, Baffin, Frobisher, 1 Aug., 1953; 62 mm., s.

F., DMNH 9035, Alaska, Wainright, 5 Aug., 1922; 67 mm., u.

M., DMNH 9034, Alaska, Wainright, 6 Aug., 1922; 67 mm., s.

F?, DMNH *9045, Alaska, Wainright, 5 Aug., 1922; 67 mm., s.

Fleshy Parts: Mouth corners yellow, feet pale grayish flesh, eyes bluish brow, (11737). Bill yellow with dusky tip, legs and feet olive gray (11800).

Natal down: 11759 and 11737 have dusky gray down on sides of crown and nape, on wings and rump.

Juvenal Plumage: Forehead and crown lead gray often tinged with brown. Crown faintly streaked with dark and light shades. Nape and upper back concolor with crown. Mid and lower back streaked (inconspicuously) buffy gray, and dark gray or black. Rump plumbeous gray, tinged with buff; upper tail coverts similar but browner. Outer three rectrices largely white with black on outer web. Other rectrices black, edged with pale cinnamon buff. Primaries and tertials black, secondaries largely white. Tertials broadly edged with rusty brown, primaries tipped with gray. Coverts black, edged with white. Middle and greater coverts broadly edged, forming two white wing-bars, the posterior confluent with white secondary patch. Lores plumbeous. Eye-ring white. Side of head concolor with crown. White patch on the posterior sub-auriculars. Auriculars lightly buffy-tinged, post-auriculars concolor with nape. Chin and throat light, grayish white. Chest light gray to plumbeous, more or less tinged with buff (individual variation). Sides grayish white to buffy gray. Belly and crissum white, more or less tinged with buff. Leg feathers white.

The plumage very soft and thick.

Alaska specimens tend to be buffier throughout (especially auriculars).

Dwight (1900:181)

Ridgway (1901:148)

Tinbergen (1939) Trans. Linn. Soc., 5:28, 35-43.

Photo of nestling. Data on natural history and behavior of nestlings.

Witherby (1948:152-153)

Natal down, colors of fleshy parts in juvenals, and data on postjuvenal molt.

Sutton and Parmelee (1954) Wilson Bull., 66:166, 174-175.

Natal down, colors of fleshy parts in juvenals, and some data on postjuvenal molt.

Sporophila torqueola (Plate 15)

M., USNM *199883, Costa Rica, S. Jose, 8 July, 1889; 15 mm., s.

M., USNM *144268, Vera Cruz, Jico, 22 June, 1893; 24 mm., s.

Juvenal Plumage: Forehead and crown uniform buffy tan, nape lighter (buffy yellow). Back buffy brown or brown. Rump and upper tail coverts buffy, about concolor with nape. Rectrices blackish. Remiges and coverts blackish gray. Lesser coverts broadly edged with buff. Median and greater coverts broadly edged with buff. Median and greater coverts tipped with buff, forming two distinct wing bars. Side of head and underparts uniformly buff colored, unmarked.

Ridgway (1901:576)

Allen (1907) Auk, 24:28-29.

Descriptions under "juv." refer to postjuvenal (immature plumage), not juvenal plumage.

Sporophila aurita

Skutch (1954) Life Histories of Central American Birds, 25-29.

Good discussion of development of nestlings, with data on juvenal plumage (shows patterns of adult female).

Arremonops rufivirgatus (Plate 16)

M., UMMZ *(HHK), Tex., Cameron Co., 25 June, 1934; 20 mm., s.
? UMMZ *66345, Tex., Cameron Co., 30 May, 1930; 38 mm., s.
F., UMMZ *66344, Tex., Cameron Co., 29 May, 1930; 42 mm., s.
F., UMMZ (HHK), Tex., Cameron Co., 1 May, 1931; 42 mm., s.
M., UMMZ *66343, Tex., Cameron Co., 29 May, 1930; 41 mm., s.
M., UMMZ (HHK), Tex., Cameron Co., 15 May, 1933; 52 mm., s.

Juvenal Plumage: Crown, nape, and forehead drab olive (Citrine-Drab), obscurely streaked with dusky. Back similar, but more heavily streaked and spotted with dusky. Rump and upper tail coverts uniform Citrine. Rectrices Dark Citrine. Remiges dark gray or blackish, primaries and secondaries edged with Dark Citrine, tertials narrowly edged with buffy. Coverts blackish edged with buffy. Lores gray, auriculars drab olive. Obscure light superciliary line. Chin and throat whitish. Lower portion of throat and rest of underparts tinged pale yellow, somewhat buffy on sides and flanks.

Chest, sides, and flanks conspicuously streaked with dusky. Belly and crissum largely unmarked, more brightly yellow than other underparts.

Ridgway (1901:447)

Arremonops conirostris conirostris (Plate 16)

F., CM *105243, Venez., Meranda, 7 Sept., 1929; 58 mm., u.

Natal down: Light gray (live nestlings). Skutch, 1954:111)

Juvenal Plumage: Forehead and crown dusky (blackish), the crown streaked with olive green. Nape and back streaked, dusky and olive green. Back with broader streaks. Rump dusky. Upper tail coverts and rectrices olive green (Citrine or Dark Citrine). Remiges dark gray, all but outer primary edged with green or olive green, except distally. Coverts gray, narrowly edged with yellow-green. No special wing pattern. Lores dusky, superciliary line yellowish green. Eye-ring not distinctively colored. Post-ocular stripe dusky. Auriculars gray-green. Chin and throat dull greenish yellow. Breast tinged yellowish and streaked with dusky. Sides and flanks uniform olive. Belly light yellow, crissum slightly deeper yellow, both unstreaked.

Arremonops conirostris umbrinus (Plate 16)

F., CM *88712, Venez., Sab. Mendoza, 4 May, 1922; 57 mm., s.

Fleshy Parts: Iris brown, feet dusky-flesh, bill blackish (above).

Juvenal Plumage: Very similar to specimen of nominate race described. Dorsally more uniformly colored, less definitely streaked. Ventrally, indistinguishable.

Arremonops conirostris richmondi

F., CMNH 6821, Costa Rica, Limon, 11 May, 1893; u.

Juvenal Plumage: Similar to specimens of conirostris and umbrinus, but more brightly colored throughout. More richly yellow underparts. Crown pattern with definite median stripe.

Skutch (1954) Life Histories of Central American Birds, 109-115.

Good discussion of development of nestlings and juvenal plumage, with data on postjuvenal molt.

Chlorura chlorura (Plate 18)

? DMNH *3274, Colo., Montezuma Co., 6 June, 1913; 34 mm., s. M., DMNH *25748, Colo., Pagonia, 20 July, 1947; 74 mm., s. M., DMNH 14383, Colo., El Paso Co., 11 July, 1912; 72 mm., s.

Juvenal Plumage: Upper parts streaked, light and dark brown. (Streaking more obscure in stub-tailed specimen.) Back with broad streaking. Nape, rump, and upper tail coverts paler than other parts. Upper tail coverts tinged strongly with buff. Rectrices dark gray, tipped (ventrally) with buff, and conspicuously edged (dorsally) with green, except distally. Remiges dark gray, primaries and secondaries edged with green (except distally). Tertials and

coverts edged with buff. Lores gray but with white line between bill (maxilla) and eye. Eye-ring whitish. Auriculars gray, post- and sub-auriculars white, forming distinct cheek patch. Chin and throat white, with distinct dusky "mustache" marks. Chest, sides, and flanks tinged buffy (most strongly on flanks), and profusely streaked with dusky. Belly white or buffy tinged white, crissum buff colored, both virtually unmarked. Leg feathers grayish.

Ridgway (1901:400-401)

Chapman (1914:352)

Bailey (1928:708)

Pipilo ocai (Plate 18)

F., MVZ *96740, Mex., Puebla, 12 July, 1946; 89 mm., s.

MVZ 96744, Mex., Puebla, 12 July, 1946; 93 mm., u.

Juvenal Plumage: Forehead and crown drab brown (Argus Brown) streaked obscurely with blackish (more on forehead). Nape similar but paler, tinged buffy at sides. Back about concolor with nape (Brussels Brown) marked with crossed streaks of black (quite unlike pattern in erythrophthalmus). Rump paler. Upper tail coverts concolor with back, obscurely marked with black. Rectrices uniform olive green. Remiges dark gray, edged with olive-green (except tertials). Tertials narrowly edged with buff. Coverts gray, lessers edged with buffy, medians and greaters edged with buffy or buffy white. Lores and feathers about eye dusky. Superciliary

tinged with light yellow. Auriculars black, forming a definite cheek patch. Sub-auriculars tinged pale yellow. Chin and throat pale yellow, flecked with dusky. Chest heavily mottled and streaked with black. Sides and flanks buffy, virtually unstreaked. Feathers in middle, upper belly and lower breast light yellow. Belly whitish (tinged with buffy), unstreaked. Crissum buff, unstreaked. Leg feathers brown. Ridgway (1901:407)

Pipilo erythrophthalmus erythrophthalmus (Plate 18)

F., GMS #6799, W. Va., Brooke Co., 28 Aug., 1935; 14 mm., s.

Fleshy Parts: Eyes dark brown; bill dusky above, flesh color below; feet purplish flesh color.

Natal down: Down on wings and rump pale brown.

Juvenal Plumage: Sexual dimorphism in this plumage as in adults (Dwight, 1900:207). Forehead and crown dark blackish brown, inconspicuously streaked with lighter brown, streaking more apparent posteriorly. Nape streaked blackish and light brown. Back like nape, but streaking broader. Rump mottled dark and light brown. Upper tail coverts largely dark brown. Wings black, tertials edged with buff. Secondary coverts tipped with light buff, forming posterior wing bar (anterior bar very indefinite). Auricular region dark blackish brown. (Chin and throat in pin feathers.) Chest, sides, and flanks (especially) buffy, heavily streaked with blackish brown. Belly whitish. Crissum rich buff, unmarked. Leg feathers buffy, mottled with dark brown.

Pipilo erythrophthalmus montanus (Plate 18)

M., UOMZ *2887, New Mex., Kit Carson N. F., 22 Aug., 1954; u.

M., DMNH 13590, Colo., Douglas Co., 26 July, 1936; u.

M., DMNH 13844, Colo., Denver, 14 Aug., 1890; u.

M., DMNH 13564, Colo., Douglas Co., 2 Aug., 1936; u.

M., DMNH 21706, Utah, Cisco, 9 Aug., 1940; u.

F., KU *12551, Neb., Sioux Co., 1 Aug., 1922; 108 mm., s.

F., KU 26709, Colo., Jefferson Co., 12 Aug., 1912; u.

Fleshy Parts: "Irides of the young are first bluish . . . then hazel and later dull orange." (Munro, 1919:73)

Juvenal Plumage: (Male) Forehead and crown dark blackish brown, crown inconspicuously streaked with light brown. Nape similar but with more light brown streaks. Back blackish, mottled with buff or light brown, and white (in scapular region). Feathers of rump and upper tail coverts blackish, edged and tipped lightly with buff or chestnut. Remiges black, primaries edged conspicuously with white at place about one-third way from distal end. Tertials conspicuously edged with white. Coverts black, secondary coverts tipped with whitish forming distinct posterior wing bar and much less conspicuous anterior bar. Lores mottled blackish and gray, auriculars blackish, post-auriculars like nape. Chin and throat whitish, lower throat, chest, sides, and flanks buffy, heavily streaked with blackish. Belly white, sparsely streaked (blackish). Crissum rich buff, feathers marked blackish along shafts. Tail black, outer

three rectrices marked with white terminally. Rectrices narrower, more rounded than first winter.

Differ from eastern birds as do adults, i.e., light spotting in scapular region of western birds.

Juvenal Plumage (Female): Forehead, crown, and nape streaked brown and buffy gray. Back streaked with, and mottled, blackish brown and buff, as is rump. Upper tail coverts dark brown edged with reddish brown. Rectrices blackish, outer three (fourth slightly) marked with white distally. Rectrices narrower than in winter adults. Remiges blackish brown, primaries edged with white in distal half, tertials edged with buffy white. Coverts dark brown, secondary coverts tipped with buffy white, forming posterior wing bar, and less conspicuous anterior wing bar. Lores and auriculars dull light brown. Chin and throat whitish faintly streaked with brownish. Chest, sides, and flanks lightly tinged with buff, chest and sides heavily streaked with dark brown. Belly whitish. Crissum rich buff (unmarked). Leg feathers buffy, mottled with brown.

Differs from male as does adult female from adult male, i.e., female, brown, male black.

Brewster (1878:122)

Dwight (1900:206-207)

Ridgway (1901:411, 424)

Chapman (1912:290)

Bailey (1928:712)

Forbush (1929) Birds of Massachusetts, 3:122.

Sketch of juvenal.

Roberts (1932) Birds of Minnesota, 2:708.

Sketch of juvenal.

Barbour (1950) American Midland Nat., 44:742-749.

Good, on early development of nestling and juvenal plumage, with illustrations of very young birds.

Pipilo fuscus mesoleucus (Plate 17)

F., KU *16702, New.Mex., Union Co., 10 July, 1927; 50 mm., s. M., KU *18034, New Mex., Eddy Co., 21 July, 1930; 95 mm., s. M., KU 18302, Ariz., Pima Co., 3 July, 1931; u.

Juvenal Plumage: No marked sexual dimorphism. Forehead, crown, and nape drab light brown indistinctly streaked with darker brown. Back uniform soft gray brown. Rump and upper tail coverts light buffy brown, coverts tipped lightly with rusty. Tail dark blackish brown (male somewhat darker). Lateral rectrices tipped with buff or rusty, especially on inner web. Remiges and coverts dark gray, primaries and secondaries narrowly edged with light gray, tertials with buff. Coverts edged with buff, greater coverts tipped with buff, forming posterior wing bar (no definite anterior bar). Lores and feathers about eye whitish. Auriculars light brown. Chin and throat whitish, heavily spotted with dusky on sides. Chest and flanks tinged with buff. Chest, sides, and flanks heavily streaked with dusky. Crissum uniform rich rusty or

buff (unmarked). Lower belly whitish and less heavily streaked than other underparts. Leg feathers rich buff, finely streaked with dusky.

Pipilo fuscus fuscus (Plate 17)

? GMS *EPE 554, Mex., Michoacan; 32 mm., s.

Juvenal Plumage: Differs from P. f. mesoleucus as follows: Streaking on underparts (of fuscus) blackish, not gray. Back coloration darker brown. Remiges blackish, not gray as in mesoleucus.

Differences are same as exemplified in adults, i.e., paler mesoleucus, darker fuscus.

Juvenal rectrices more rounded than those of adult, and possess larger amount of buff-tipping.

Brewster (1879:41)

P. f. crissalis.

Chapman (1914:219)

Bailey (1928:715)

Van Rossem (1935) Trans. San Diego Soc. Nat. Hist., 8:70.

Geographic variation shown in form described (P. f. eremophilus).

Davis (1951:5)

Pipilo aberti (Plate 17)

M., KU *18311, Ariz., Maricopa Co., 24 June, 1931; 108 mm., u.

F., KU *18377, Ariz., Maricopa Co., 25 June, 1931; 106 mm., u.

Fleshy Parts: "Iris light brown; bill brownish horn

color above, bluish beneath; legs brown." (Brewster, 1882:199)

Juvenal Plumage: No sexual dimorphism. Forehead, crown, nape, and back drab light brown. Rump and upper tail coverts similar, tinged with rusty. Rectrices dark brown, the tips tinged rusty. Remiges drab brown, lighter than tail. Primaries and secondaries narrowly edged with light gray, tertials with rusty. Coverts concolor with tertials, greater coverts tipped with rufous, forming narrow posterior wing bar. Side of the head about concolor with crown. Chin, throat, chest, sides, and belly light buffy brown. Dusky "mustache" marks on sides of chin, and suggestion of gray streaking in mid-ventral region. Flanks, lower belly, leg feathers and crissum uniform rich rusty.

Brewster (1882) Bull. Nutt. Orn. Club, 7:199.

First description.

Ridgway (1901:427)

Chapman (1912:21)

Calamospiza melanocorys (Plate 19)

? DMNH *19048, Colo., Adams Co., 15 July, 1938; 6 mm., s.

? KU *6184, Kansas? No date; 60 mm., s.

M., DMNH 10935, Colo., 1 Aug., 1938; 53 mm., s.

M., DMNH 13923, Colo., Denver, 28 June, 1885; 47 mm., s.

Fleshy Parts: "The lower mandible is yellowish, upper as in adult." (Roberts, 1932:707)

Natal down: 19048 has tufts of buffy-tinted, whitish

down on sides of crown and scapular region.

Juvenal Plumage: No sexual dimorphism. Forehead blackish brown, feathers edged with cream or buff, crown streaked blackish and buff or cream in older juvenals, but in stub-tailed birds presents a scaled appearance. Occiput more strongly tinged with buff. Nape buffy or cream, streaked with blackish. Back feathers blackish brown, edged with cream (scaled back pattern). Rump similar but more buffy. Rectrices blackish, edged with cream and tipped with white, especially on inner web. Outermost pair with larger white patch. Remiges blackish, primaries edged with white, secondaries and tertials edged with buff or cream. Coverts black-tipped and edged with cream or buff. Wing patch extends from bend of wing to greater coverts. Eye-ring cream colored. Superciliary line buffy. Auriculars light brown, sub- and postauriculars white, forming a definite cheek pattern (as in adult female). Chin and throat white, spotted with black (sides especially), forming irregular "mustache" marks. Chest, sides, and flanks light buffy, profusely streaked with black. Belly white, crissum buffy, both unmarked.

Considerable variation (individual) in amount of ventral streaking. Juvenal rectrices with more white than adult.

Ridgway (1901:168)

Chapman (1914:269)

Roberts (1932) Birds of Minnesota, 2:707.

Passerculus sandwichensis savanna (Plate 20)

M., GMS *7629, W. Va., Preston Co., 30 June, 1937; 47 mm., u.
M., CMNH *19204, Q., Magdalen Isl., 8 Aug., 1908; 21 mm., s.
M., CMNH *19203, Q., Magdalen Isl., 8 Aug., 1908; 28 mm., s.
? CMNH 293, Q., Magdalen Isl., June-July, 1887; 43 mm., s.
? CMNH 294, Q., Magdalen Isl., June-July, 1887; 43 mm., s.
F., CMNH *11127, Mass., Monomoy, 19 Aug., 1904; 42 mm., s.

Natal down: 19204 has tufts of brownish down on sides of crown and nape. 19203 has tufts of light brown down on wings.

Juvenal Plumage: No sexual dimorphism. Forehead and crown profusely streaked golden brown, buff and black. Median stripe of buffy yellow, sometimes, obscure, and light superciliaries. Nape similar to crown but black streaking much reduced. Back streaked black (heavily), and shades of golden brown and buffy yellow. Rump buffy or buffy brown streaked with black. Upper tail coverts dark brown, broadly edged with buffy brown. Remiges black, outer primary edged white. Other remiges edged with rusty brown. Tertials broadly so, except uppermost which is edged with buffy white. Coverts black, lessers and medians edged with buffy white. Greaters edged with rust and tipped with buffy white (definite wing bars). Lores buffy, anterior end of superciliary yellow. Superciliary whitish streaked with black. Eye-ring white or buffy white. Auriculars buff or sandy, partially margined in black. Post-auriculars white streaked with black.

Sub-auriculars buffy yellow (cheek patch about auriculars). Underparts buffy yellow, marked with black "mustaches." Jugulum, chest, sides, and flanks streaked with black or dark brown. Buffy yellow darkest on chest, lightest on belly (white in worn specimens). Crissum whitish or buffy yellow.

Passerculus sandwichensis alaudinus (Plate 20)

F., MVZ *16852, Calif., Humbolt Co., 17 Aug., 1910; 14 mm., s.

M., MVZ *34998, Calif., Santa Clara Co., 24 May, 1901; 25 mm., s.

M., MVZ *29097, Calif., Marin Co., 12 May, 1918; 23 mm., s.

Natal down: 16852 has tufts of down about crown (brown), and on rump and wings (pale buffy).

Juvenal Plumage: Similar to savanna described but black streaking of crown and back much narrower, buffy yellow coloration paler. Ventral streaking very different from savanna. California birds very finely and rather sparsely streaked on chest, sides, and flanks.

Brewster (1878:118)

P. s. savanna.

Dwight (1900:168 and 187)

Plumages and molts of P. s. princeps and savanna.

Ridgway (1901:191)

P. s. sandwichensis.

Forbush (1929) Birds of Massachusetts, 3:54.

Photo (black and white) of stub-tailed juvenal (savanna).

Ammospiza maritima maritima

F., GMS 10426, Del., Sussex Co., 20 Sept., 1948; 50 mm., u.

F?, GMS CEA 684, Del., Sussex Co., 23 Sept., 1948; 48 mm., u.

Juvenal Plumage: Feathers above nostrils white. Forehead and crown streaked black, olive, and Olive Brown. Nape Olive Brown. Back, feathers black, edged with Olive Brown and buff (pattern: heavy black streaks on Olive Brown). Rump buffy or buffy brown obscurely marked with black. Upper tail coverts Olive Brown streaked with black. Rectrices Olive Brown, black along each shaft. Remiges black, edged with drab, tertials edged with dull rusty brown and tipped with buffy white. Median and greater coverts black, edged with buff. No wing bar pattern. Lores buffy gray. Superciliary (in front of eye) buffy-yellow. Post-ocular stripe buff; feathers around eye gray or buffy gray. Auriculars gray; sub- and post-auriculars light buff (distinct cheek patch). Chin and throat white with dusky "mustache" marks. Upper chest, sides, and flanks buff, streaked with dark brown or blackish (amount of streaking variable). Belly white, crissum buff, both unmarked. Leg feathers buffy or buffy gray.

Ammospiza maritima waynei

M., GMS 11404, S. C., Jones Isl., 28 June, 1952; 49 mm., s.

Juvenal Plumage: Similar to A. m. maritima described, but crown virtually unstreaked.

Ammospiza maritima juncicola

M., GMS 11423, Fla., Wakulla Co., 4 July, 1952; 50 mm., s.

F., GMS 11425, Fla., Wakulla Co., 4 July, 1952; s.

These specimens badly worn, but appear similar to A. m. maritima described.

Brewster (1878:119)

A. m. maritima.

Chapman (1899) Auk, 16:9-11.

Brief notes on a few races of this species.

Dwight (1900:192)

Chapman (1910:113-114)

Forbush (1929) Birds of Massachussetts, 3:66.

Sketch (black and white) of juvenal (nominate race).

Griscom (1944:322-324)

Discusses patterns of various races. A. m. sennetti without ventral streaking.

Pough (1946) Audubon Bird Guide. Color Plate 46.

Ammospiza nigrescens

M., AMNH 401103, Fla., Merritts Isl., 13 May, 1910;

(A nestling largely in juvenal pin feathers.)

Juvenal Plumage: Above, black, nape and back feathers edged with buff (less buff-edging on crown). Below, buffy white broadly streaked with black on chest and sides (chin and throat feathers undeveloped).

Ammospiza caudacuta subvirgata (Plate 21)

M., GMS *CEA 722, Can., N. B., 4 Aug., 1949; 49 mm., u.

F., GMS *CEA 721, Can., N. Bruns., 4 Aug., 1949; 45 mm., u.

Fleshy Parts: "Bill and feet pinkish buff, the former becoming dusky, the latter sepia-brown with age." (Dwight, 1900:191)

Natal down: "The natal down varies from brownish black on the head to mouse gray on the rump." Also distribution. (Rand, 1929:243)

Juvenal Plumage: No sexual dimorphism. Crown black, with broad median and superciliary stripes of rich olive-tinged buff. Nape rust-tinged buff, unstreaked. Feathers of back black, broadly edged with rich buff. Rump and upper-tail coverts rich buff, obscurely marked with black. Rectrices olive gray with black shafts. Remiges black, primaries edged with gray, tertials with rich buff, as are coverts. Throughout upperparts, buff coloration distinctly tinged with olive. Lores and eye-ring buff, like superciliary. Auriculars brown, partially margined with black post-ocular stripe. Sub- and post-auriculars rich buff. Underparts rich orangish buff (lightest on belly). Sides of chest with few obscure black streaks. Underparts otherwise immaculate.

Ammospiza caudacuta nelsoni (Plate 21)

F., UMMZ *131362, N. Dak., Kidder Co., 24 Aug., 1952; 28 mm.,s.

F., UMMZ *135518, N. Dak., Kidder Co., 26 Aug., 1953; 35 mm.,s.

M., UMMZ #135517, N. Dak., Kidder Co., 26 Aug., 1953; 39 mm.,s. M., UMMZ #135516, N. D., 26 Aug., 1953; 48 mm., u.

Juvenal Plumage: Males exhibit more ventral streaking than do females. Forehead and crown black, with broad superciliaries and broad, irregular median stripe of Orange-Buff (about). Nape light chestnut. Feathers of back black, broadly edged with orangish buff. Rump orange buff. Upper tail coverts similar but black along feather shafts. Rectrices black along shaft, edged with olive-tinted buff. Remiges blackish, primaries and secondaries edged with olive gray, tertials broadly edged with orangish buff. Coverts black, edged with orangish buff. Lores buffy. Side of head rich orangish buff, with post-ocular stripe of black. Underparts orangish buff, (richer anteriorly). Sides of jugulum, and chest with few fine streaks of black. Ventral streaking variable. Leg feathers dusky and buff.

Dwight (1887) Auk, 4:234.

Dwight (1900:190-192)

Chapman (1910:113)

Rand (1929) Auk, 46:243-244.

Summary of published data on A. c. subvirgata. Information on natal down, and development of juvenal plumage.

Breckenridge (1930) Univ. of Minn. Mus. Nat. Hist. Occ.

Papers, 3:32 and Frontispiece.

Comparison of A. c. nelsoni and Leconte's Sparrow; color plate showing both species.

Roberts (1932) Birds of Minnesota, 2:725 and Plate 83.

A. c. nelsoni; good color plate.

Dumont (1934:62)

Reports four "juvenals" of A. c. nelsoni in Iowa.

Pough (1946) Audubon Bird Guide. Color Plate 46.

Ammospiza (Passerherbulus) lecontei (Plates 21 and 22)

M., UOMZ RRG *2891, Okla., Clevel. Co., 2 Oct., 1954; 54 mm.,u.

M., GMS *11176, Mich., Jackson Co., 14 Sept., 1951; 48 mm., u.

Natal down: "Grayish." (Walkinshaw, 1937:313)

Juvenal Plumage: Forehead and crown black, with broad sagittal and superciliary stripes of buffy yellow. Nape rich yellow-buff, unmarked. Back feathers black, edged with buffy yellow. Rump feathers and upper tail coverts black, broadly edged with buffy yellow. Rectrices pinkish buff with black shafts. Remiges black, edged with buffy pink, tertials broadly edged with buff and buffy pink. Coverts black, broadly edged with buffy yellow. Lores and eye-ring buff. Auriculars brownish, partially margined by a black post-ocular stripe. Post- and sub-auriculars buffy, unmarked. Chin, throat, chest, sides, flanks, and crissum light buff; belly white or buffy white. Chest and sides finely streaked, flanks more heavily streaked, with black.

Patterns exhibited, like those of all forms of Ammospiza.

Roberts (1879) Bull. Nutt. Orn. Club, 4:153.

Variation in neutral streaking described.

Chapman (1910) 18 and frontispiece--color plate.

Breckenridge (1930) Univ. Minnesota Mus. Nat. Hist. Occ. Pap., 3:34 and frontispiece.

Comparison of Ammospiza caudacuta and Leconte's Sparrow; color plate of the two.

Roberts (1932) Birds of Minnesota, 2:724 and Color Plate 83.

Pough (1946) Audubon Bird Guide. Color Plate 46.

Passerherbulus henslowi (Plate 22)

F., KU #30499, Kan., Anderson Co., 16 June, 1951; 11mm., s. M., KU #26815, Kan., Douglas Co., 3 Aug., 1907; u.

Natal down: Tufts of whitish buffy white down on posterior portions of body of 30499. "Smoke-gray." (Dwight, 1900:189) "Pale Buffy gray." Also gives distribution. (Hyde, 1939:55)

Juvenal Plumage: Males darker dorsally. (Sutton, 1935:24) Median and superciliary stripes of olive-tinted buff, mottled with blackish. Back feathers black, edged with buff (broadly). A scaled pattern. Rump rich buff, upper tail coverts blackish, edged with buff. Rectrices pointed, rusty-tinged buff, blackish along shaft. Remiges slate gray, light edged. Upper tertials and all coverts blackish, edged with buff. Auriculars and post-auriculars olive-tinted buff, marked with black. Sub-auriculars and underparts light yellowish buff, buffier on flanks and

crissum. Underparts practically immaculate, though lightly marked on sides of upper chest, and flanks with sparse blackish streaks.

Brewster (1878:118)

Dwight (1900:189-190)

Fuertes (1910) Bird-Lore, 12:opp. p. 1.

Color plate showing juvenal with winter scapulars.

Sutton (1935:23-26)

Hyde (1939:55-57)

Summary of work of Sutton (largely), and others.

Ammodramus savannarum (Plate 23)

F., UOMZ *1259, Okla., Love.Co., 13 July, 1954; 26 mm., s.

F., UOMZ 1267, Okla., Love Co., 13 July, 1954; 40 mm., u.

F., UOMZ *1261, Okla., Love Co., 13 July, 1954; u.

Fleshy Parts: "Bill and feet pinkish buff, the former becoming dusky, the latter deep brown when older." (Dwight, 1900:188)

Juvenal Plumage: No sexual dimorphism. Forehead and crown streaked, brown and black, with median and superciliary stripes of light buff or buffy white (in older birds). Nape mottled, buffy white and black. Back, feathers black, edged with buff or buffy brown (scaled pattern). Rump black, feathers edged buffy or buffy brown. Upper tail coverts black, edged with buff. Rectrices black, narrowly edged with buff, except median pair (broadly edged). Remiges slate gray

or blackish, edged with buff or buffy brown. Tertials black, edged with white. Lesser and median coverts black, edged with buff, tipped with white. Lores buffy, eye-ring buffy white. Superciliary buffy white, streaked with black. Auriculars buffy brown. Post-auriculars concolor with nape. Underparts white or buffy white, more strongly tinged with buff on chest, sides, flanks, and crissum. Upper chest rather sparsely streaked with blackish or dark brown. Other underparts unmarked.

Stub-tailed bird much darker throughout than older birds.

Four GMS specimens (3F., 1M.) from W. Va., similar in every way to Oklahoma specimens.

Dwight (1900:188-189)

See Sutton (1935)

Ridgway (1901:206)

A. s. savannarum.

Forbush (1929) Birds of Massachussetts, 3:56.

Sketch (black and white) of juvenal.

Sutton (1935:20-23)

Sutton (1936:1-8)

Color plate of stub-tailed juvenal (p. 8).

Ammodramus bairdi (Plate 23)

M., ROMZ *29469, Man., Deer Lodge, 7 Aug., 1931; 22 mm., s. ("13 to 14 days old")

F., ROMZ *29470, Man., St. Charles, 22 Aug., 1931; 50 mm., u.

M., ROMZ *29183, Sask., Elmore, 15 Aug., 1922; 44 mm., s.
M., ROMZ 7895, Ariz., Ft. Graham, 21 Sept., 1873; 54 mm., u.
F., AMNH 518578, Ariz., Mt. Graham, 21 Sept., 1873; u.
M., AMNH 518579, Ariz., Camp Grant, 22 Sept., 1873; u.

Fleshy Parts: "Iris rich dark brown; bill pinkish-grey suffused along the culmen with brownish which intensifies as the yojng become older, lower mandible pale pink; tarsi, feet and claws pale pink, translucent." (Cartwright, Shortt, and Harris, 1937:176)

Juvenal Plumage: The following quoted in part from Cartwright, Shortt, and Harris (1937:176-177). Statements in parentheses or not in quotes, mine. "The juvenal plumage is as follows: loral region and forehead black, sparsely tipped with buff; crown black tipped with buff, more buffy in the centre, showing an indistinct median line; superciliary line buff; ("buff," is Ochraceous-Buff or Light Ochraceous-Buff) auriculars buff tipped with black; malar region buff; nape and hindneck black edged with buff; back black edged with pale buff, giving a scaly appearance; rump black edged with ochraceous-buff; (upper tail coverts and rectrices black, edged with buffy brown or buffy white) scapulars black edged with buff, paler at the tips). Remiges blackish gray, primaries edged with buffy white, tertials margined with buffy brown and white. Coverts black, lessers and greaters edged with cinnamon buff. Median and greater coverts tipped with buffy white. Side of head Ochraceous-Buff, auriculars

largely outlined in black (cheek patch as in Passerculus). Underparts whitish, strongly tinged with buff anteriorly and on sides. Chin with black "mustache" marks extending to sides of throat. Jugulum, chest, and sides conspicuously streaked with black. Belly and crissum white, unmarked. Leg feathers white, marked with black.

"The colors are more intense than any plumage of the adult and the breast and side markings are heavier."
Ridgway (1901:203)
Roberts (1932) Birds of Minnesota, 2:722.
Cartwright, Shortt, and Harris (1937:172-177 and 190-192)

Excellent discussion of development of juvenals; list of locality records of juvenals.

Pooecetes gramineus confinis (Plate 24)

? DMNH, Colo., Jackson Co., 11 July, 1914; 8 mm., s.
? DMNH *3489, Colo., Conejos Co., 30 July, 1913;63 mm., u.
? DMNH 4021, Colo., Jackson Co., 11 July, 1914; 9 mm., s.
? DMNH 4029, Colo., Jackson Co., 11 July, 1914; 9 mm., s.
? DMNH *4030, Colo., Jackson Co., 11 July, 1914; 12 mm., s.

Juvenal Plumage: Lores gray, whitish above nostrils. Forehead streaked, brown and black. Suggestion of white median streak. Crown streaked, light brown or buff, and black. Nape similar but lighter. Feathers of back black, broadly edged with buffy white. Upper tail coverts black edged with buffy gray. Outer pair of rectrices white,

others largely black, medians edged with tan. Remiges black, outer primaries edged whitish, tertials edged rusty and tipped white. Coverts black, lessers edged with buff, medians with white, greaters edged with buff, tipped with whitish. Two obscure wing bars. Eye-ring white. Super- and post-ocular stripe white. Auriculars mottled black, and white or buff. Sub- and post-auriculars white, latter streaked with black (cheek patch around dark auriculars). Chin and throat white (lateral black "mustache" marks), sparsely spotted with black. Other underparts white; chest, sides, and flanks streaked with black. Leg feathers white marked with dusky.

Pooecetes gramineus gramineus (Plate 24)

F., GMS *9301, W. Va., Preston Co., 5 July, 1940; 26 mm., s.

Fleshy Parts: "Feet and bill pinkish buff darkening little with age." (Dwight, 1900:185)

Natal down: "Mouse gray down . . . crown, nape, and back." (Sutton, 1941:8)

Juvenal Plumage: Similar to P. g. confinis described, but dorsum much darker (no white in back). Crown and back streaked with brown (not buff or light brown) and black. Tertials' edgings brown, not buff.

Pooecetes gramineus affinis (Plate 24)

M., DMNH *15224, Can., B. C., Okanagan, 27 June, 1919; 55 mm., s.

Fleshy Parts: Iris dull hazel.

Juvenal Plumage: Similar to P. g. gramineus. Much darker dorsally than P. g. confinis described, black back feathers only narrowly margined with whitish. Superciliary more distinct and complete. Tertial edgings brownish not buff.

Brewster (1879:40)

See Sutton's (1935:26) comments.

Dwight (1900:185)

Sutton (1935:26-28)

_____ (1941:1-10, Pl. 1)

Development of juvenal plumage. Color plate showing stub-tailed juvenal.

Chondestes grammacus (Plate 25)

F., GMS RRG 2452, Mex., Tamps., 6 Aug., 1953; 10 mm., s.

F., UOMZ 1340, Okla., Norman, 5 June, 1954; 22 mm., s.

M., GMS *11114, Okla., Marshall Co., 8 June, 1951; 17 mm., s.

F., UOMZ *1226, Okla., Marshall Co., 16 June, 1954; 32 mm., s.

Fleshy Parts: Mouth lining dull purplish red, mouth corners very pale yellow, tarsi gray, toes grayish flesh color, (11114); iris dark brown, feet light brown, bill light horn (RRG 2452).

Juvenal Plumage: Lores dusky in stub-tailed birds (superciliary not complete). Supra- and post-ocular stripe buffy white. Median crown stripe white or buffy white. Otherwise, forehead and crown brown, streaked with dark brown

or blackish. Feathers of hind-neck and back black edged with buff or buffy white. (Pattern heavy streaking of black and buff.) Rump and upper tail coverts buffy or buffy brown, obscurely streaked with black. Rectrices black, outer four (at least) marked white terminally. Remiges black, outer primary edged with white. Tertials edged with buff or buffy white. Lesser and median coverts black, edged with light buffy. Greaters edged with cinnamon, tipped with buffy white (two wing-bars). Eye-ring and feathers about eye white. Auriculars light brown, dark-margined. Post- and sub-auriculars white (definite cheek-patch). Underparts white, more or less buffy-tinged on chest, sides, flanks, and crissum. Chest, sides, and flanks profusely streaked with black. Belly (lower) and crissum immaculate. Leg feathers white.

Older birds less buffy.

Brewster (1878:121)

Dwight (1900:193)

Chapman (1911:89)

Forbush (1929) Birds of Massachusetts, 3: Color Plate 69 (opposite p. 62).

Specimen illustrated much lighter, and more sparsely streaked than any specimen I have seen (western birds only). Head colors also much brighter.

Roberts (1932) Birds of Minnesota, 2:722 and Color Plate 84.

Aimophila aestivalis (Plate 26)

F., GMS *11380, Ga., Grady Co., 26 May, 1952; 29 mm., s.

F., GMS *(HLS), Ga., Grady Co., 30 May, 1948; 43 mm., s.

F., GMS (HLS), Ga., Grady Co., 27 May, 1948; 46 mm., s.

M., GMS (HLS), Ga., Grady Co., 30 May, 1948; 54 mm., s.

M., GMS (HLS), Ga., Grady Co., 29 May, 1948; 57 mm., s.

(Third specimen notably redder than other specimens; may represent color phase.)

Juvenal Plumage: Forehead and crown feathers black, edged (in varying amounts) with buffy brown or reddish brown; pattern irregular streaking. Youngest specimen with least light feather edging (nearly uniform black crown). Nape similar but more light edging. Back similar, feathers broader. Rump with black much reduced, light color predominating. Upper tail coverts like back. Rectrices blackish with faint suggestion of "herring-bone" pattern. Remiges blackish, primaries edged with buffy, tertials with rich cinnamon. Tertials margined with cinnamon and buff. Coverts black, lessers edged with rich cinnamon, medians and greaters narrowly edged with buff or cinnamon buff. Wing bar pattern not prominent. Lores buffy. No distinctive face pattern. Auriculars tinged with buff, spotted with black. Underparts whitish or cream, tinged with buff on flanks and crissum. Chin finely spotted with black; throat, breast, sides, and flanks streaked and spotted with black (most heavily on breast). Leg feathers black and cream.

Aimophila cassini (Plate 26)

M., KU 16747, Kans., Logan Co., 10 Aug., 1927; 62 mm., s.
M., UMMZ *(HHK), Tex., Cameron Co., 4 June, 1934; 60 mm., s.
F., UMMZ *(HHK), Tex., Cameron Co., 13 May, 1933; 60 mm., s.

Juvenal Plumage: Feathers of forehead and crown blackish brown, edged with light buff (pattern irregular streaking). Nape cream, streaked with dark brown. Back feathers blackish, edged with cream (scaled pattern). Rump similar but lighter. Longest upper tail coverts black along shaft, edged with light reddish brown. Deck rectrices vary from dull gray to light rusty brown (color phases?); suggestion of barring from black "herring bone" pattern along shaft. Other rectrices largely black, narrowly light edged, and marked (ventrally) with dull white, terminally. Primaries edged with white, secondaries and tertials with cinnamon buff. Secondaries edged terminally with white, tertials margined with white. Coverts, like remiges, black. Lessers and greaters edged with cinnamon buff, medians and greaters tipped with white (two narrow wing bars). Lores and eye-ring whitish. Obscure superciliary line, white streaked with black. Side of head tinged with buffy, flecked with dark brown. Underparts light cream colored; chin, throat, breast, sides, and flanks conspicuously streaked with black. Belly and crissum unmarked. Crissum more richly colored than other underparts. Leg feathers brown and cream.

Aimophila botterii (Plate 26)

M., GMS RRG 2380, Mex., Tamps., 21 July, 1953;

(Downy young without other feathers)

F., GMS *RRG 2485, Mex., Tamps., 15 Aug., 1953; 59 mm., s.

M., UMMZ (HHK), Tex., Cameron Co., 16 July, 1932; 63 mm., u.

Fleshy parts: Bill yellow-flesh color, iris dark brown, feet flesh color (2380); iris dark brown, lower mandible yellowish pink, feet yellowish-flesh (2485).

Natal down: Pale buffy gray on crown and nape; lighter (whitish) on back, wings, and sides of rump.

Juvenal Plumage: Feathers of forehead and crown and back blackish, edged with buffy gray. Nape buffy gray, much less black than crown. Rump mottled buffy and black. Upper tail coverts and median rectrices black, broadly edged with Brussels Brown. Other rectrices black. Remiges slate gray (tertials black), primaries edged with gray, tertials with rusty. Tertials margined with buff. Wing coverts black, lessers and medians edged with creamy buff, greaters edged with cinnamon, tipped with buff. Two wing-bars. Lores light gray. Superciliary line cream, and most prominent anterior to eye. Eye-ring cream colored. Side of head uniform buffy gray. Chin and throat cream, with bare suggestion of "mustache" marks. Other underparts cream, belly most richly colored. Chest and flanks tinged with pinkish buff. Jugulum, chest, sides, and flanks streaked with dusky. Belly and crissum unmarked. Leg feathers cream, marked with dusky.

Aimophila carpalis (Plate 26)

F., MVZ *116675, Mex., Sonora, 1 Nov., 1946; 29 mm., s.

M., MVZ *116676, Mex., Sonora, 1 Nov., 1946; 29 mm., s.

Juvenal Plumage: Forehead, crown, and back broadly streaked, Buffy Brown and blackish. Suggestion of light, median crown stripe. Nape less distinctly streaked. Rump and upper tail coverts Buffy Brown, slightly darker than back, streaked (sparsely on rump) with blackish. Rectrices and remiges black. Primaries edged with whitish, tertials margined with Walnut Brown, and (terminally) creamy buff. Two wing bars. Creamy buff superciliary (rather obscure, especially anterior to eye). Auriculars buffy brown. Chin and throat white, lightly flecked with dusky. Dusky "mustache" marks at sides of chin. Underparts white, tinged with buff on flanks and crissum. Chest, sides, and flanks streaked finely with black (heaviest on breast). Belly and crissum unmarked.

Aimophila mysticalis (Plate 26)

F., USNM *135476, Mex., Puebla, 22 July, 1893; 70 mm., s.

Juvenal Plumage: Forehead dusky gray or blackish. Crown streaked, dusky and Mouse Gray. Nape similar, but paler and streaked with broad black marks. Rump uniform Cinnamon-Rufous. Rectrices black, narrowly edged with gray. Remiges slate gray (tertials blackish). Primaries and secondaries white-edged, tertials margined with light buffy.

Coverts black, medians and greaters broadly tipped with creamy white (two distinct wing-bars). Greater coverts narrowly edged with light cinnamon. Lores black. Cream-colored line between bill and eye. Eye-ring white. Patch below eye black. Superciliary line obscure except anterior to eye. Auriculars gray. Pattern in malar region as in adult, cream colored malar stripe outlined in black (sub-ocular region and sides of chin). Chin and throat white, flecked with dusky. Other underparts (except crissum) white, tinged with buff on breast. Breast and sides heavily streaked with dusky. Belly and flanks largely white. Crissum rich orangish buff.

Aimophila humeralis (Plate 26)

F., GMS *EPE 1433, Mex., Puebla, 30 July, 1952; 64 mm., s.

Juvenal Plumage: Forehead, crown, and nape Drab (Ridgway). Hind-neck Drab, obscurely streaked with dusky. Back about Wood Brown. Upper tail coverts similar, but slightly tinged with rusty. Rectrices blackish gray, narrowly light edged, and much rounded. Remiges slate gray, primaries edged with buffy white, secondaries and tertials with light rusty. Upper tertials margined with light buff. Coverts dark gray. Greaters edged with cinnamon, tipped with buff. Medians tipped with buff (solid wing patch). Lores and feathers about eye spot of cream between eye and bill, near nostrils. Auriculars and post-auriculars Drab. Pattern in malar region as in adult (also as in juvenal mysticalis). White malar

stripe, partially outlined by dusky stripes. Chin, throat, and belly white, unmarked. Chest, sides, and flanks tinged with buffy, chest finely streaked with dusky (most conspicuous on jugulum). Crissum rich buff, unmarked.

Aimophila ruficauda (Plate 27)

? UMMZ #130913, Mex., Michoacan, 8 Aug., 1950; 14 mm., s. F., AMNH #397877, Guat., Progreso, 11 Sept., 1924.

Juvenal Plumage: Forehead and crown blackish. Superciliary line white. Median stripe buffy, or buffy white. Nape and back buffy brown, conspicuously streaked with black. (Streaks broadest posteriorly.) Rump darker brown, very sparsely marked with dusky. Upper tail coverts and rectrices about concolor with rump. Remiges black, primaries and secondarkes edged, tertials margined, with buffy brown. Wing coverts black; lessers broadly edged with cinnamon brown, greaters and medians buffy brown or cinnamon brown. Light wing patch. Underparts (except flanks and crissum) white. Breast and sides finely and sparsely streaked with dusky gray. Flanks and crissum rich pinkish buff, crissum unmarked. Leg feathers white (brownish at heel).

Aimophila sumichrasti (Plate 27)

F., GMS EPE 106, Mex., Oaxaca, 13 July, 1946; 48 mm., s.

Juvenal Plumage: Forehead and crown Prout's Brown, obscurely mottled and streaked with dusky. Inconspicuous lighter sagittal stripe. Broad, cream superciliary. Nape

similar to crown, but paler. Back Buffy Brown, streaked with broad dusky marks. Rump buffy gray, obscurely mottled with dusky. Upper tail coverts rusty. Rectrices largely rust colored. Remiges blackish, primaries edged with buffy white, upper secondaries and tertials with cinnamon. Tertials margined with cinnamon-buff. Coverts blackish, lessers broadly edged with cinnamon. Primary coverts, and greaters edged with cinnamon, medians and greaters tipped with buffy. Lores blackish. Dusky eye-stripe interrupts cream colored eye-ring. Auriculars uniform buffy white. Short "mustache" mark under eye--extending from base of mandible; longer mark on side of chin and throat. "Mustaches" pattern like that in adult, but less conspicuous. Chin and throat white. Chest and flanks strongly tinged with dull buff. Breast (by jugulum) finely streaked with gray. Lower breast and belly white, unmarked. Crissum and leg feathers light buffy, unmarked.

Aimophila ruficeps (Plate 27)

F., GMS 9092, Ariz., Santa Rita Mts., 23 May, 1940; 65 mm., s. M., UOMZ 2750, Okla., Blaine Co., 2 July, 1901; 70 mm., u. M., UOMZ 1250, Okla., Marshall Co., 2 July, 1954; 66 mm., u.

Juvenal Plumage: Forehead and crown (only faintly streaked) about Cinnamon Brown (slightly paler medially). Nape about Mouse Gray, mottled with Cinnamon Brown. Back irregularly streaked with Cinnamon Brown (on gray), and blackish. Rump dark brown, upper tail coverts, lighter, rusty

brown. Rectrices dull rust. Remiges dark gray (tertials blackish). Primaries and secondaries edged with light gray, tertials broadly edged with dull rust, tipped with buffy white. Coverts blackish, edged with buffy white (two narrow wing bars). Lores light gray, superciliary gray (contrasts with crown but not side of head). Chin and throat white, with dusky "mustache" marks. Other underparts whitish, flanks tinged with buff. Chest, sides, and flanks (much less so) streaked with dusky (heaviest on breast). Belly and crissum unmarked.

Pough (1946) Audubon Bird Guide. Color Plate 45.

Aimophila rufescens (Plate 27)

F?, CM *113443, Mex., Guerrero, 27 Aug., 1931; 72 mm., u.

M., CM *117755, Hond., Tegucigalpa, 30 Oct., 1934; u.

F., GMS EPE 1484, Mex., Chiapas, 5 Aug., 1952; u.

Juvenal Plumage: Forehead and crown heavily streaked, blackish and brown. Median stripe (crown) Grayish Olive. Nape and hindneck Grayish Olive, streaked with blackish. Back about Brussels Brown, streaked with blackish. Rump, buffy gray. Rectrices dull gray brown. Remiges blackish brown, primaries edged with buff, tertials with chestnut. Lesser and median coverts edged with Grayish Olive. Greaters edged with light chestnut, tipped narrowly with buff (no conspicuous wing-bar pattern). Eye-ring cream colored, interrupted by black eye line. Superciliary line pale yellowish.

Lores dusky. Auriculars tinged with olive. Sub-auriculars, chin, and throat pale yellow. Black "mustache" marks. Underparts pale yellow or rich creamy yellow; sides, flanks, and crissum tinged with buffy gray. Chest and sides streaked conspicuously, with black. Belly and crissum unmarked. Leg feathers Grayish Olive.

Amphispiza bilineata (Plate 28)

M., GMS *10830, Mex., Nuevo Leon, 9 May, 1941; 25 mm., s.
F., GMS *11218, Ariz., Pima Co., 12 June, 1940; 57 mm., u.
M., KU 18101, New Mex., Eddy Co., 22 July, 1930; 60 mm., u.
M., DMNH 23211, Ariz., Pinal Co., 2 May, 1941; 51 mm., s.
M., DMNH 23214, Ariz., Pinal Co., 4 May, 1941; 59 mm., s.
F., DMNH 21229, Utah, Harley Dome, 7 July, 1940; 60 mm., s.
M., DMNH 23217, Ariz., Pinal Co., 6 May 1941; 61 mm., s.
M., DMNH 22128, Utah, Cisco, 9 Aug., 1940; 59 mm., u.

Fleshy Parts: Bill dark horn, feet light gray, corners of mouth pale creamy white, iris dark brown, (Notes of Mrs. John Whitaker on specimen a few days out of nest.)

Juvenal Plumage: No sexual dimorphism. Forehead and crown Dark Mouse Gray. Nape and upper back lightly brown-tinged gray. Back light buffy brown with traces of dark streaks. Rump grayish, or brownish gray. Upper tail coverts brown (darker than back). Rectrices black, outer pair marked with white terminally, and on outer web. (Amount of white variable.) Remiges blackish, not as dark as tail. Tertials

edged with light rusty. Coverts blackish, edged with light rusty or sand color. Greater coverts tipped with buff (indistinct posterior wing bar). Lores gray. White superciliary line not extending to nape. Interrupted eye-ring white. Auriculars and post-auriculars gray. Sub-auriculars and underparts (except crissum) white. Lower throat mottled with gray. Chest, upper belly, and sides streaked rather finely with gray. Suggestion of gray breast spot. Belly and crissum unmarked, crissum light buffy. Leg feathers white marked with gray.

Brewster (1882) Bull. Nutt. Orn. Club, 7:195.

Ridgway (1901:263-264)

Chapman (1913:242)

Amphispiza belli (Plate 28)

F., DMNH #22127, Utah, Cisco, 8 June, 1940; 70 mm., u.

? MVZ (Cal.) 2040, Calif., Banning, 11 June, 1908; 44 mm., s.

Juvenal Plumage: Forehead and crown gray, conspicuously streaked with black. Nape concolor, virtually unstreaked. Back buffy gray, marked with broad black streaks. Rump buffy, obscurely marked with black. Upper tail coverts brown, obscurely dark streaked. Rectrices black, outer pair with buffy outer web. Remiges black, primaries light edged, tertials broadly edged with cinnamon. Lesser coverts light brown, streaked with black. Medians blackish, tipped with buffy white. Greaters edged with buff, tipped with buffy

white. Two wing bars. Eye-ring white. Lores and feathers about eye dusky. Feathers above lores white, rest of superciliary gray. Post-auriculars light gray streaked with black. Sub auriculars white. Chin and throat white, with black "mustache" marks. Chest, sides, and flanks buff-tinged white, conspicuously streaked with black. Lower belly and crissum unstreaked, crissum buffy. Leg feathers brown and white.

Ridgway (1901:267, 269, 270)

Description of A. b. belli, summary descriptions for A. b. cinerea and nevadensis.

Junco vulcani (Plate 29)

F?, UMMZ #133588, Costa Rica, 28 April, 1951; 65 mm., s. M., UMMZ #133590, Costa Rica, 28 August, 1950; 69 mm., s.

133588 decidedly browner, less gray than 133590.

Fleshy Parts: Iris yellow (133590).

Juvenal Plumage: (133588) Forehead and crown Brussels Brown, irregularly streaked with black. Nape concolor with crown medially, grayer laterally, and posteriorly. Back Brussels Brown, feathers tipped and marked distally on shaft with triangle of black (anchor-shaped black mark). Rump Brussels Brown, obscurely marked with black. Upper tail coverts unmarked. Rectrices black, narrowly edged with brown, tipped with buffy white. Remiges black, primaries edged with buff, and tertials more broadly edged with russet.

Coverts black; edged with russet, medians and greaters narrowly tipped with buffy. Lores and feathers anterior to eye black. Superciliary grayish. Auriculars drab buffy gray, sub- and post-auriculars paler. Chin and throat buffy gray (marked with blackish at sides), flecked with black. Chest, sides, and flanks buffy, streaked with black. Belly and crissum buffy white, unmarked.

Junco alticola (Plate 29)

M., UMMZ *103591, Mex., Chiapas, 22 Mar., 1939; 68 mm., u.

Juvenal Plumage: Forehead and crown and nape about Dark Olive-Gray, streaked rather obscurely with dusky. Back Cinnamon-Brown, streaked with black. Rump concolor with back, unstreaked. Upper tail coverts buffy brown, sparsely streaked with black. Rectrices blackish, narrowly edged with brown. Outer two pairs marked with white distally on inner web, outermost with most white. Remiges black, primaries and secondaries edged with gray, tertials broadly edged with dull chestnut. Lesser coverts grayish. Others black; medians tipped with white, greaters edged with rusty and tipped with white. Lores dusky. Side of head concolor with crown, with less black streaking. Chin and throat white, flecked with black (more heavily on sides). Sides, flanks, and crissum tinged with rich buff. Other underparts white, heavily streaked (except belly and crissum) with black.

Junco fulvescens (Plates 29 and 30)

F., CMNH *209404, Mex., Chiapas, 13 Aug., 1950; 57 mm., u.

Juvenal Plumage: Forehead gray, crown brown-tinged gray, both streaked rather finely with black. Nape similar, more brown tinged. Back Brussels Brown sparsely streaked with black. Rump and upper tail coverts light rusty brown, obscurely dark-streaked. Rectrices dark gray (blackish), edged with rust, two outermost largely white. Remiges blackish; primaries edged with white. Secondaries edged with light gray, and inner (upper) secondaries with rust. Tertials and greater coverts broadly edged with Chestnut. Lesser coverts gray. Medians and greaters black, narrowly tipped with whitish (suggestion of wing bars). Lores black, as are feathers around eye. Auriculars buffy gray. Chin and throat white, flecked with black. Chest whitish, streaked with black. Sides and flanks buffy, obscurely streaked with black. Crissum buff, unmarked. Belly white. Leg feathers gray.

Ridgway (1901:302)

Junco bairdi (Plate 29)

F., MVZ *116103, Mex., Baja Calif., 12 June, 1947; 54 mm., s.

F., MVZ *55548, Mex., Baja Calif., 2 Aug., 1929; 60 mm., u.

Juvenal Plumage: Feathers above nostrils whitish. Forehead, crown, and nape light gray or buffy tinged gray, streaked and spotted finely with dusky. Back light rusty

(Ochraceous-Tawny), very sparsely flecked or streaked with dusky. Rump and upper tail coverts sandy or buffy, unmarked. Rectrices gray, narrowly light edged. Outermost rectrix white, second from outer largely white. Remiges blackish; primaries edged with white, secondaries with gray. Tertials and greater coverts broadly edged with Cinnamon Brown. Lesser coverts and medians grayish, latter narrowly light edged. No wing-bar pattern. Lores black. Side of head light gray or buffy white, unmarked. Chin and throat light gray. Chest, sides, and flanks tinged light buff, sparsely flecked with dusky. Belly white, crissum buffy white. Leg feathers light gray.

The least heavily streaked Junco.

Ridgway (1901:295)

Junco phaeonotus phaeonotus (Plate 30)

F., USNM *143885, Mex., Vera Cruz, 6 July, 1893; 33 mm., s.

F., USNM *159186, Mex., Durango, 22 July, 1898; 61 mm., s.

? USNM 38169, Mex., Orizaba, No date; 67 mm., u.

Natal down: Tuft of mouse gray down on side of crown of 143885.

Juvenal Plumage: Forehead, crown, and nape gray, finely streaked with black. Back rusty red, streaked with black. Scapulars gray or buffy gray, streaked with black. Rump and upper tail coverts buffy gray, obscurely streaked with dark. Rectrices black, except outer two pairs largely

white. Remiges black; primaries edged with white, tertials broadly edged with Burnt Sienna (rusty red). Lesser and median coverts gray, narrowly edged with buff. Greater coverts edged with Chestnut, tipped with buff (narrowly). No wing bar pattern. Lores black. Black feathers nearly circumscribe eye (in a patch). Auriculars gray, obscurely streaked with dark. Chin and throat white flecked with black (especially on sides). Chest, sides, and flanks streaked with black (triangular marks pointing anteriorly). Underparts largely white, sides and flanks tinged with buffy. Belly and crissum largely unmarked. Leg feathers gray, edged white.

Tertial edgings in J. phaeonotus much more rusty red than in J. caniceps (including J. c. dorsalis), which has tertials edged gray.

Junco phaeonotus australis (Plate 30)

M., USNM *143847, Mex., Michoacan, 28 July, 1892; 68 mm., u.

Juvenal Plumage: Similar to nominate race, but tertial edgings, greater coverts edgings, and back notably brighter (Sanfords Brown), lighter red. Amount of back streaking also reduced.

Junco phaeonotus palliatus (Plate 30)

F., USNM *258637, Ariz., 13 June, 1914; 41 mm., s.

M., DMNH 5577, Ariz., Huachuca Mts., 2 Oct., 1913; 74 mm., u.

Juvenal Plumage: Similar to nominate race described, but slightly paler throughout upperparts. Back color similar

to that in Junco caniceps dorsalis, which has tertials edged with gray, not rufous.

Brewster (1885) Auk, 2:198.

Description under J. cinereus.

Ridgway (1901:299-300)

Junco caniceps caniceps (Plate 30)

M., GMS #2836, Colo., Gunnison Co., 29 Aug., 1954; 39 mm., s. M., KU #1385, Colo., Las Animas Co., 17 July, 1954; 26 mm., s.

Natal down: 1385 has smoky gray down on rump; 2836 has down on side of crown.

Juvenal Plumage: Forehead and crown gray, heavily streaked with black. Nape tinged with buff. Back Mahogany Red, streaked with black. Rump buffy, obscurely streaked with blackish. Upper tail coverts buffy gray, obscurely spotted with blackish. Rectrices blackish gray, except outer two pairs white and third from outside about half white. Remiges black, narrowly white-edged (tertials edged with Mouse Gray). Coverts edged with gray. Secondary coverts tipped with whitish (two obscure wing bars). Lores dark gray. Auriculars gray, post-auriculars like nape. Sub-auriculars streaked, blackish and white. Chin and throat white, obscurely spotted with gray. Underparts largely white, the sides and flanks light buffy. Chest, and sides streaked with blackish (triangular marks with apex anterior). Belly and crissum white. Legs gray.

Junco caniceps dorsalis (Plate 30)

M., KU 17928, New Mex., Catron Co., 7 July, 1929; 55 mm., s.

M., KU *17929, New Mex., Catron Co., 7 July 1929; 56 mm., s.

Juvenal Plumage: Forehead light gray. Crown and nape gray, streaked with black (nape more sparsely). Back light rusty (Burnt Sienna of Ridgway), sparsely streaked with black. Rump and upper tail coverts light, buffy-tinged gray, sparsely streaked with blackish. Rectrices largely dark gray, outer two pairs white (some white on third from outside). Remiges black, narrowly light edged (tertials broadly edged with gray). Coverts edged with gray and buff, secondary coverts tipped narrowly with white (narrow wing bars). Lores black. Auriculars and post-auriculars gray, unmarked. Chin unmarked whitish. Other underparts white. Throat, chest, sides, and flanks finely spotted and streaked with blackish. Legs gray.

Ridgway (1901:296)

Rockwell (1910) Condor 12:165.

Describes downy young.

Junco oreganus oreganus (Plate 31)

F., KU *621, Alaska, Sitka, 4 July, 1896; 46 mm., s.

Juvenal Plumage: Forehead and crown streaked profusely, brown and dark brown (without great contrast). Nape concolor with crown medially, grayer laterally. Back Russet, streaked with blackish brown. Rump gray brown, upper tail

coverts dark brown, both obscurely streaked with darker brown. Tail largely blackish brown, outer two pairs of rectrices white. Remiges blackish; outer primaries edged with white, secondaries and tertials with rusty. Coverts edged with rusty brown, greater coverts tipped with whitish or buffy white (two narrow wing bars). Lores dusky. Auriculars drab gray brown. Post-auriculars like nape. Sub-auriculars, chin, and throat heavily streaked, blackish and buffy white. Chest and sides strongly tinged with buffy, other underparts white or buffy white. Chest, sides, and flanks heavily streaked with dark (blackish) brown. Leg feathers brown. Crissum unstreaked.

Junco oreganus mearnsi (Plate 31)

M., KU #27408, Idaho, Custer Co., 16 Aug., 1948; 67 mm., s.

F., KU #27421, Idaho, Blaine Co., 31 Aug., 1948; 65 mm., s.

Juvenal Plumage: Forehead, crown, and nape gray, profusely streaked with black. Back Cinnamon Brown, marked with heavy black streaks. Rump and upper tail coverts buffy gray, obscurely streaked with black. Outer pair of rectrices white, second from outer largely white. Others black, narrowly edged with gray. Remiges black, primaries and secondaries light gray-edged. Tertials edged broadly with dull pink. Lesser coverts gray, medians (black-tipped) buffy white. Greater coverts edged with buff, tipped with buffy white. Two obscure buffy white wing bars. Lores black.

Sides of head gray, rather obscurely spotted with black. Chin and throat grayish white spotted and streaked with black. Chest, sides, and flanks tinged with buff, streaked with black. Belly and crissum white, unmarked. Leg feathers gray and white.

Much like J. hyemalis but back pinkish brown, and crown lighter gray.

Ridgway (1901:284 and 290)

J. o. oreganus and montanus.

Dawson (1923) Birds of California, 1:288 and Plate opp. p. 290.

Color plate very good but misleading, since it is captioned "Male and female,. . ." and shows adult male and a juvenal bird. Adult female very different from juvenal.

Junco aikeni (Plate 31)

M., MVZ *98948, Mont., Big Horn Co., 1 July, 1947; 75 mm., u.

Natal down: "Dry black down." (Miller, 1948:92)

Juvenal plumage: Forehead and crown gray, streaked profusely with black. Nape similar, tinged with brown. Back brown-tinged gray, streaked with black. Rump and upper tail coverts grayish, obscurely streaked with black. Outer three rectrices largely white; others black, edged gray (fourth from outside with white mark). Remiges black, primaries and secondaries edged light gray. Tertials edged with pinkish-buff, tipped with buffy-white. Lesser coverts

grayish, medians black, narrowly white-tipped. Greaters edged with buff, tipped buffy white. Two narrow wing-bars. Lores gray, eye-ring white. Auriculars gray. Post-auriculars white, sparsely spotted with dusky (cheek patch partially outlining auriculars). Chin and throat grayish white (lateral black streaks), obscurely flecked with dusky. Sides of chest gray. Chest, sides, and flanks tinged with buff, streaked with black. Belly white, crissum buffy white, both unmarked. Leg feathers gray and white.

Much like J. hyemalis, though clearly distinguishable.

Junco hyemalis hyemalis (Plate 31)

F., GMS *KCP 183, N. Y., Tompkins Co., 5 July, 1948; 60 mm., s.

Natal down: "Slate-gray" (Dwight, 1900:200).

Juvenal Plumage: Very like J. h. carolinensis described below, but slightly browner throughout.

Junco hyemalis carolinensis (Plate 31)

F., GMS 8904, W. Va., Tucker Co., 10 July, 1939; 69 mm., s.

F., GMS 8914, W. Va., Tucker Co., 11 July, 1939; 67 mm., s.

F., GMS *8915, W. Va., Tucker Co., 11 July, 1939; 68 mm., s.

F., GMS *8916, W. Va., Tucker Co., 11 July, 1939; 62 mm., u.

Juvenal Plumage: Crown and nape dull gray, uniformly streaked with black. Back tinged slightly with brown, rather sparsely streaked with black. Rump gray brown, mottled with blackish. Uppertail coverts drab gray brown, obscurely

streaked with blackish. Outer two pairs of rectrices largely white, third from outside with some white, other black. Remiges black; primaries and secondaries edged with whitish, tertials with buff or buffy gray. Coverts edged with buff. Lores, eye-ring, and side of head rather flat gray (uniform, except auriculars, lightly flecked with dusky). Chin and throat light gray or whitish, streaked and spotted (obscurely in some specimens) with blackish. Chest buff-tinted gray, or buff; sides and flanks buffy. Chest and sides streaked rather heavily with blackish. Belly and crissum unmarked white. Legs gray.

Brewster (1878:120-121)

Dwight (1900:200)

Ridgway (1901:279)

Mentions sexual dimorphism in juvenal J. h. hyemalis.

Chapman (1914:442)

Forbush (1929) Birds of Massachussetts, 3:85-86.

Description and sketch (black and white).

Roberts (1932) Birds of Minnesota, 2:710 and Plate 85.

Excellent color plate.

Spizella pusilla (Plate 32)

M., KU *29909, Kans., Douglas Co., 2 Sept., 1950; 18 mm., s.

M., GMS *8919, W. Va., Marion Co., 12 July, 1939; 63 mm., s.

Much variation in color, and also in amount of streaking. Older specimen more rufous; younger, grayer.

Natal down: Tuft of light gray down on wing of 29909. "Mouse-gray." (Dwight, 1900:199)

Juvenal Plumage: (29909) Forehead and crown dull gray, tinged brown posteriorly. Nape flat gray. Back light gray buff, streaked with blackish. Rump and upper tail coverts gray buff, unstreaked. Rectrices blackish, outer two pairs edged with whitish. Remiges blackish; secondaries and primaries edged with white, tertials with pale rusty. Coverts dark gray, edged with pale buff; medians and greaters tipped with buffy white (two narrow wing bars). Lores gray, eye-ring cream. Auriculars gray, tinged with brown. Post auriculars like nape. Chin and throat whitish, unmarked. Breast, flanks (crissum slightly), tinged with buff. Underparts largely whitish; breast, sides, and flanks finely streaked with grayish. (Older specimen much more heavily streaked.)

Brewster (1878:121)

Comparison of S. passerina with S. pusilla.

Dwight (1900:199)

Ridgway (1901:318)

S. p. pusilla.

Chapman (1910:17)

Eaton (1914) Birds of New York, 2:Plate 83.

Color plate showing specimen in early stages of post-juvenal molt.

Forbush (1929) Birds of Massachussetts, 3:83.

Sketch (black and white) of juvenal.

Roberts (1932) Birds of Minnesota, 2:715 and Color Plate 86.

Sutton (1935:29-31 and Color Plate VII)

Walkinshaw (1939) Bird-Banding, 10:149.

Data on down and fleshy parts of nestling.

Spizella atrogularis (Plate 32)

F?, MVZ *53945, Calif., Alameda Co., June, 1928; 23 mm., s. M., MVZ *97180, Calif., S. Bernardino Co., 3 July, 1946; 69 mm., u.

Juvenal Plumage: Crown plumbeous to blackish (younger specimen), nape concolor with crown. Back streaked, buff or brown, and black. Rump and upper tail coverts buffy gray, obscurely streaked with black. Rectrices black, edged with light gray or white. Remiges black, edged with buffy white (except tertials). Tertials broadly edged with pale rust. Lesser, median, and greater coverts black, edged and tipped with rust or buff. No wing-bar pattern. Eye-ring whitish, but not bright. Lores plumbeous gray. Side of head flat gray (rather light). Chin and throat gray, unmarked. Chest gray, becoming white on belly. Crissum white. Older bird faintly streaked with black on chest, upper belly, and sides. Young specimen conspicuously streaked ventrally, except crissum and lower belly.

Like pusilla this species quite variable in ventral streaking character.

Ridgway (1901:323)

Chapman (1912:106)

States that this plumage is unstreaked.

Dawson (1923) Birds of California, 1:309.

Bailey (1928:750)

Spizella taverneri

F., MVZ 44851, Can., B. C., Atlin, 6 Aug., 1924; 47 mm., s.

Juvenal Plumage: Crown streaked heavily, black and shades of buffy brown. Lores gray-white. Narrow superciliary white, finely streaked with black. Nape gray, streaked with black. Back streaked heavily, black and buff. Rump similar, grayer. Upper tail coverts black, edged with light buff. Rectrices black, edged with buff. Remiges black; primaries edged with buffy white, tertials broadly edged with rust, and buffy white (terminally). Middle and greater coverts edged and tipped with buffy or buffy white. Two wing bars. Eye-ring white. Auriculars gray brown, post-auriculars concolor with nape. Chin and throat white, streaked finely with black. Chest, upper belly, sides, and flanks very heavily streaked with black (a condition which makes this plumage instantly recognizeable from breweri). Lower belly whitish, crissum white or buff-tinged white.

Swarth and Brooks (1925:68)

Comparative notes on taverneri and breweri.

Spizella breweri (Plate 33)

M., KU *29099, Nev., Churchill Co., 22 Aug., 1941; 61 mm., u.

? DMNH 4088, Colo., Jackson Co., 6 July, 1914; 35 mm., s.

? DMNH *4031, Colo., Jackson Co., 8 July, 1914; 41 mm., s.

M., DMNH 11011, Colo., Weld Co., 4 Aug., 1923; 45 mm., s.

F., DMNH 14069, Colo., Dolores, 4 Aug., 1904; 62 mm., u.

M., DMNH 3418, Colo., Medicine Bow R., Aug., 1913; 63 mm., u.

Natal down: 4031 has tuft of fuscous down on side of crown.

Juvenal Plumage: No sexual dimorphism. Crown streaked blackish and light rufous buff. Nape streaked, blackish and light brownish gray. Back heavily streaked, about concolor with crown. Upper tail coverts grayish streaked black along shaft. Rectrices blackish, narrowly light edged. Remiges and coverts blackish; primaries edged with whitish, secondaries and tertials with light rusty. Upper tertials tipped with whitish, or buffy. Coverts edged with buff, secondary coverts tipped with whitish or buff (two wing bars). Lores, superciliary, and feathers about eye whitish or buffy white. Auriculars pale buff-gray (obscure cheek patch), post-auriculars concolor with nape. Sub-auriculars, chin, and throat white, inconspicuously flecked with black. Underparts white. Chest, upper belly, and sides streaked narrowly with black (triangular shaped marks pointing anteriorly). Flanks sparsely streaked. Belly and crissum white, unmarked or finely streaked on belly.

Much like S. passerina. Differs in having wing bars whiter (less buffy), covert edgings grayer. S. passerina is more rufous in scapular region and crown than breweri (probably the most distinctive difference).

Swarth and Brooks (1925) Condor, 27:68.

Comparative notes on S. breweri and taverneri.

Ridgway (1901:327)

Chapman (1910:17-18)

Dawson (1923) Birds of Calif., 1:312.

Spizella passerina passerina (Plate 33)

F., GMS 8311, W. Va., Brooke Co., 28 June, 1938; 5 mm., s. M., GMS *9713, W. Va., Hardy Co., 5 July, 1941; 21 mm., s. F., GMS *8898, W. Va., Preston Co., 8 July, 1939; 45 mm., s.

Natal down: 8311 has large amount of fuscous-gray down on crown and rump.

Juvenal Plumage: No marked sexual dimorphism. Crown striped, brown and black. Suggestion of buffy stripe (lighter than lateral portions of crown, not as distinct as in pallida). Nape lighter (grayish), especially in the older juvenals. Back streaked, blackish and light (buffy) brown. Rump and upper tail coverts paler, streaked buffy gray and blackish. Rectrices dark gray, edged with buff (median), or whitish (lateral). Remiges blackish; primaries and some secondaries edged with buffy white, secondaries and tertials with rusty (upper tertials tipped with buff). Coverts edged

and tipped with buff and buffy white (two wing bars). Lores dark brown (younger specimens) to whitish. Eye-ring whitish or cream. Superciliary (poorly defined in younger specimens) whitish, finely streaked with gray or brown. Auriculars light buffy gray, post-auriculars concolor with nape. Chin and throat white, inconspicuously flecked with gray (some specimens). Other underparts white, conspicuously streaked with blackish. Lower belly, and crissum with only a few dark marks. Tail, ventrally, light gray. Leg feathers white with few dark marks.

See under S. breweri.

Spizella passerina arizonae

M., GMS 2858, Okla., Cimarron Co., 22 Sept., 1954; 64 mm., u.

F., GMS (no number), Okla., Cimmaron Co., 19 Sept., 1954; 61 mm., u.

M., GMS 11453, Okla., Cleveland Co., 5 Oct., 1952; 61 mm., u.

Juvenal Plumage: Pale by comparison with eastern specimens. Lightest back feathers rather pale buff. Tertials tipped with whitish instead of buff. Rectrices edged with white instead of buff. Amount of ventral streaking not reduced in western birds.

Brewster (1878:121)

S. p. passerina.

Dwight (1900:198-199)

Ridgway (1901:312 and 314)

Chapman (1910:16)

Comparative notes on various species of Spizella.

Dawson (1923) Birds of California, 1:302.

S. p. arizonae.

Roberts (1932) Birds of Minnesota, 2:Color Plate 86.

Sutton (1935:28-29 and Color Plate IV).

_____. (1937)

Development of juvenal plumage and early stages of postjuvenal molt (S. p. passerina).

Walkinshaw (1944) Wilson Bull., 56:200-201.

Comparative notes on S. passerina and pusilla.

Spizella pallida (Plate 33)

M., GMS HBT 671, Mich., Crawford Co., July, 1949; 11 mm., s.

F., GMS *HBT 670, Mich., Crawford Co., July, 1949; 28 mm., s.

M., GMS HBT 668, Mich., Crawford Co., July, 1949; 44 mm., s.

Natal down: Tufts of fuscous down on sides of crown, and remiges.

Juvenal Plumage: As in adult, crown three-parted with pale buffy or whitish median streak, and lateral darker brown or gray brown parts, all uniformly streaked with blackish. Nape silvery gray with little or no streaking. Back streaked buffy brown and black. Rump and upper tail coverts buffy, obscurely streaked with blackish. Rectrices blackish edged with buffy (median), or buffy white (lateral). Remiges blackish, light edged. Uppermost tertial edged with light

buff, others with light rusty. Coverts edged with light rust, secondary coverts tipped with buff (two wing bars). Lores buffy or whitish, eye-ring buff. Superciliary buff or whitish. Auriculars buffy, or light brown, irregularly marked with darker brown. Post-auriculars like nape, sub-auriculars similar, or whitish. Hint of dark mustache mark on chin. Chin and throat white, obscurely marked with pin-point gray flecks. Chest, sides, and flanks markedly tinged with buffy, suggesting pattern of Melospiza lincolni, and streaked with dark brown or blackish. Belly and crissum white. Legs white, marked with brownish. Tail (ventrally) light gray.

Ridgway (1901:325)

Roberts (1932) Birds of Minnesota, 2:721 and Color Plate 86.

Walkinshaw (1939) Wilson Bull., 51:20.

Sutton (Personal file, Norman, Oklahoma)

Unpublished water color painting of stub-tailed juvenal.

Spizella arborea (Plate 33)

? AMH *, Manitoba, Churchill, 9 July, 1933; (10 days old).

? AMH, Manitoba, Churchill, 22 July, 1933; 41 mm., s.

? AMH *, Manitoba, Churchill, 2 Aug., 1934; 57 mm., s.

? KU 20810, Manitoba, Churchill, July 22, 1933; s.

Natal down: See Baumgartner (1938:70). Tufts of fuscous down on sides of crown and nape. (10-day-old specimen)

Juvenal Plumage: Crown more or less red-tinged brown, streaked with blackish brown (rather obscurely so in some specimens). Nape concolor with crown centrally, whitish or buff laterally. Back heavily streaked and mottled, black, buffy or buffy gray, and rusty (in scapular region). Rump and upper tail coverts obscurely streaked with blackish. Tail blackish (slate gray), middle rectrices edged with cinnamon, laterals with whitish or light gray. Remiges slate gray, primaries edged with whitish, secondaries with buffy, and tertials broadly edged with rusty. Coverts edged with rusty, secondary coverts tipped with white (two wing bars). Lores, superciliary, sub- and post-auriculars whitish (light gray), or buffy. Auriculars mottled with brown. Post-orbital stripe (under superciliary) brown or red-brown. Underparts whitish, tinged with buff on sides of chest and flanks. Underparts (except lower belly and crissum) heavily streaked with blackish brown. Blackish breast spot less definite in some specimens. Chin and throat obscurely spotted with blackish.

The most extensively and coarsely streaked Spizella (approached only by taverneri in this respect). S. arborea resembles Zonotrichia leucophrys, but lacks a median crown crown stripe (definite in the Zonotrichia) and is more rufous dorsally.

Dwight (1900:197-198)

Ridgway (1901:308)

Chapman (1910:16-17)

Baumgartner (1938:70-72)

Development of nestling.

_____. (1938) Auk, pp. 603-608.

Zonotrichia albicollis (Plate 34)

? UMMZ 33253, Mich., Isle Royale, 7 July, 1905; 16 mm., s.

? UMMZ 33243, Mich., Isle Royale, 7 Aug., 1905; 15 mm., s.

M., UMMZ 112857, Mich., Iron Co., 16 July, 1944; 28 mm., s.

? UMMZ 40129, Mich,, Dickinson Co., 3 Aug., 1909; 27 mm., s.

? UMMZ 33242, Mich., Marquette, 4 Aug., 1905; 38 mm., s.

? UMMZ 40127, Mich., Dickinson Co., 12 July, 1909; 24 mm.,s.

M., UMMZ *101588, Mich., Chippewa Co., June, 1938; 30 mm., s.

F., UMMZ 101589, Mich., Chippewa Co., June, 1938; 30 mm., s.

F., UMMZ 101595, Mich., Chippewa Co., July, 1938; 40 mm., s.

M., UMMZ 101598, Mich., Chippewa Co., Aug., 1938; 52 mm., s.

? UMMZ 40130, Mich., Dickinson Co., 7 Aug., 1909; 57 mm., s.

F., UMMZ * 69483, Mich., Baraga Co., 8 July, 1932; 59 mm., s.

Fleshy Parts: "Bill light, becoming pale slate; legs and feet pale flesh." (Roberts, 1932:718)

Natal down: Tufts of clove brown down on crowns of 33243, 33253, and 112857. "Pale clove-brown." (Dwight, 1900:196)

Juvenal Plumage: Males with brighter (more yellow) lore-color, than females. Feathers above nostrils whitish. Forehead, crown, and nape about Chestnut-Brown, streaked

obscurely with black. Distinct median stripe buffy white. Back Chestnut, streaked profusely with black (some feathers edged with buff). Rump and upper tail coverts brown or rusty brown, obscurely streaked with black. Rectrices blackish medially, broadly edged with rusty. Remiges black, primaries edged with whitish, secondaries and tertials with chestnut. Tertials broadly edged with chestnut, tipped with buff. Coverts black; lessers edged with rust, medians tipped with white or buffy white, and greaters edged with rust and tipped whitish. Lores gray or dusky. White or buffy white superciliary line extends to nape. Eye-ring white, interrupted dusky eye-stripe. Auriculars gray, mottled with dusky. Postauriculars streaked, brown and buffy. Chin and throat whitish, flecked with dusky, and with blackish "mustache" marks. Chest, sides, and flanks tinged with buffy, heavily streaked with black. Belly and crissum white, both largely unmarked.

Brewster (1878:121)

Dwight (1900:196)

Ridgway (1901:344)

Chapman (1912:105)

Roberts (1932) Birds of Minnesota, 2:718 and Color Plate 87.

Lores not bright yellow as shown in plate, but buffy or pale-yellow-tinged.

Zonotrichia querula (Plates 34 and 35)

M., CM *113483, Man., Churchill, 25 July, 1931; 60 mm., s.

M., CM *119026, Man., Churchill, 16 Aug., 1936; 84 mm., s.

Juvenal Plumage: Forehead and crown streaked very heavily with black, finely with cream or pale buff. Sides of occiput creamy buff in 113483. Nape and posterior occipital region dull chestnut, obscurely mottled with dark. Posterior nape and hind-neck pale buff, streaked with blackish. Back streaked and mottled, black and buff. Rump grayer mottled with blackish. Longest upper tail coverts light brown. Rectrices blackish, narrowly light edged. Remiges blackish, primaries narrowly edged with buffy white, secondaries and tertials with rust (upper tertials conspicuously so). Lesser coverts gray; medians black, edged with white; greaters edged with buff, tipped with buffy white. Two narrow white wing bars. Lores grayish, superciliary region and eye-ring light buff. Auriculars dull buff, immaculate, or marked with dark brown. Sub-auriculars black. Chin and throat white, spotted with black. The center of chest marked with conspicuous black spot. Chest, sides, and flanks buffy-tinged white, heavily streaked with black. Belly white (immaculate). Crissum pale buff, flecked with dark brown. Leg feathers dark brown, broadly light edged.

Chapman (1913:304)

Gabrielson and Jewett (1940) Birds of Oregon, p. 575.

Description (from Preble).

Zonotrichia coronata (Plate 34)

F., MVZ #42297, Can., B. C., Hazelton, July, 1921; 60 mm., s.

M., MVZ #42301, Can., B. C., Hazelton, July, 1921; 72 mm., s.

Juvenal Plumage: No obvious sexual dimorphism. Feathers above nostrils light brown. Forehead and crown brown laterally, light buff medially. Light median area expands posteriorly. Entire crown streaked with black, least heavily on occiput. (A suggestion of light crown spot of adult.) Occiput and nape tinged with rusty brown, laterally. Back streaked with black and shades of buffy brown. Rump and upper tail coverts light brown obscurely marked with dark. Rectrices dull brown. Remiges dark gray (upper tertials black); primaries edged with buffy white, tertials with rust tipped with buffy white. Lesser coverts light brown, middle coverts blackish tipped with white. Greater coverts edged with rust, tipped with white. Two rather narrow wing-bars. Lores gray. Eye-ring buff above, whitish below. Auriculars mottled with gray, buff, and brown. Post-auriculars whitish, streaked with brown or black. Chin and throat whitish, flecked with black. Sides of chin and throat heavily marked, with black. Underparts cream colored, not white as in other Zonotrichia. Chest, sides, and flanks heavily streaked with black. Belly and crissum aparsely spotted with black. Leg feathers brown and cream.

Chapman (1913:304)

Gabrielson and Jewett (1940) Birds of Oregon, p. 581.

Description under "young" does not refer to juvenal plumage (no mention of ventral streaking).

Zonotrichia leucophrys leucophrys (Plate 34)

F., GMS *2823, Colo., Gunnison Co., 26 Aug., 1954; 44 mm., s.

? DMNH 25275, Labrador, 21 July, 1946; 64 mm., s.

Fleshy Parts: Iris dark brown, feet horn color, bill dark horn, gape yellow (2823).

Natal down: 2823 has tufts of light brown or cinnamon down on sides of crown.

Juvenal Plumage: Forehead and crown streaked throughout with black. Crown and forehead white medially, brown laterally. Occiput dark, mottled brown and black. Nape mottled, white and black. Back streaked, black and buff. Rump and upper tail coverts rusty-buff, streaked with black. Rectrices and remiges black. Primaries edged with buff, secondaries and tertials with dull rust color. Uppermost (proximal) tertials edged and tipped with buffy white. Lesser coverts gray; medians black, edged with white; greaters black, edged with buff, tipped with white. Two white wing bars. Lores dark, brownish or gray. Narrow white supraocular stripe from eye to nape. Auriculars buff-tinged gray, post-auriculars like nape. Chin and throat white, flecked with black, and with black "mustache" marks. Underparts white, or lightly tinged with buff on chest, sides, and crissum. Chest, sides, and flanks heavily streaked with

black. Belly and crissum immaculate. Leg feathers dark brown, edged with white.

Zonotrichia leucophrys gambeli (Plate 34 and 36)

M., KU *24745, Yukon Terr., 7 July, 1947; 57 mm., s.

Juvenal Plumage: Like nominate race but generally paler dorsally, less heavily streaked ventrally. Superciliary line extends to bill (lores white). Light median crown patch more conspicuous. Back browner, dark stripes not so black. Rump, and wing edgings, paler; tertial edgings light rust, not chestnut. Rectrices (dorsal aspect) not as black, more brown.

Brewster (1878:121)

Dwight (1900:194)

Ridgway (1901:337)

Chapman (1912:106)

Dawson (1923) Birds of Calif., 1:320 and 331.

Comparison of Z. l. leucophrys and Z. l. nuttalli.

Zonotrichia capensis chilensis (Plate 36)

M., CM *123585, Chile, P. Montt, 21 Mar., 1939; 51 mm., s.

M., CM *123567, Chile, P. Montt, 20 Mar., 1939; 61 mm., u.

M., CM *123533, Chile, P. Cosma, 15 Mar., 1939; 61 mm., u.

Juvenal Plumage: Forehead and crown evenly streaked; gray or light brown (different birds), and blackish or dark brown. Suggestion of paler median streak. Sides of occiput and nape whitish. Nape, otherwise, light brown obscurely

dark streaked. Back streaked, light buffy-brown and blackish. Rump paler, light buff mottled with brown or blackish. Rectrices black, middle ones edged with brown. Remiges black, primaries edged with buff. Tertials edged with rusty, uppermost tipped with white or buffy white. Lesser coverts gray; medians black, edged with white; greaters edged with buff, tipped white. Two white wing-bars. Lores gray, eye-ring whitish. Postocular stripe white, streaked with black. Auriculars light gray or brown, margined with dark brown or black. Chin and throat white, spotted at sides with blackish. Sides of lower throat and upper chest tinged with light rust. Underparts otherwise white, with chest, sides, and flanks streaked and spotted with black. Belly and crissum white, virtually unmarked. Leg feathers brown and white.

Zonotrichia capensis septentrionalis

M., GMS HOW 524, Mex., Chiapas, 21 Apr., 1942; 48 mm., s.

Fleshy Parts: Iris gray-brown.

Juvenal Plumage: Differs from Z. c. chilensis described as follows: light buffy patch on crown (occiput); post-ocular stripe extended into buffy superciliary line; more coarsely streaked on back, and buffier ventrally, than chilensis.

Zonotrichia capensis peruviana (Plate 36)

M., CM *35131, Venezuela, 13 Oct., 1910; 52 mm., s.

F., CM *70616, Colombia, 16 Sept., 1918; 52 mm., u.

M., CM *104173, Venezuela, 4 April, 1929; 55 mm., u.

F., CM 59388, Colombia, 8 Feb., 1917; 56 mm., u.

M., CM 107009, Venezuela, 18 Jan., 1930; 52 mm., u.

Fleshy Parts: Iris brown, legs dusky flesh or flesh (F), feet darker, bill blackish, pale horn below at base (70616 and 35131).

Juvenal Plumage: Similar to Z. c. chilensis described, but more rusty at sides of throat and chest, buffier on breast. Dorsally, browner (less gray). Median stripe more distinct. Closer to Z. c. septentrionalis than chilensis. Back pattern in peruviana more like that of Z. albicollis, chilensis more like Z. leucophrys.

Zonotrichia capensis insularis (Plate 36)

M., CM *88371, Curacao Isl., 20 April, 1922; 57 mm., u.

Fleshy Parts: Iris brown, feet brown horn, bill blackish horn, bluish below.

Juvenal Plumage: Patterns similar to Z. c. chilensis described. Nearly complete superciliaries white. Conspicuous gray crown stripe gray. Back rich sandy buff. Sides of throat and chest pale rusty, breast tinged with pale rust. Ventral streaking finer, much reduced, virtually restricted to chest.

Chapman (1940:385-386 and 412-413)

Discussion of juvenal patterns, and postjuvenal molt.

Passerella georgiana (Plate 37)

F., GMS *8906, W. Va., Tucker Co., 10 July, 1939; 21 mm., s.

F., GMS *10971, Mich., Schoolcraft Co., July 1949; 40 mm., s.

Natal down: 8906 has tufts of pale fuscous down on rump. 10971 with fuscous (darker than the above) down on side of crown.

Juvenal Plumage: Forehead and crown blackish, bissected by buffy median stripe (extends to the nape). Nape concolor with crown (8906), or gray, mottled with black (10971). Back feathers black, irregularly streaked and mottled with rich buff, or brown. Rump and upper tail coverts buffy brown mottled with black. Rectrices blackish, edged with rust. Remiges slate gray edged with rust (tertials black edged with rust and buff). Lesser, middle, and greater coverts black, edged with buff. Lores and superciliary (flecked with dark) gray or buffy gray. Auriculars buff, partially margined by black. Post-auriculars concolor with nape, sub-auriculars buffy. Suggestion of black "mustache" marks. Chin and throat whitish, inconspicuously marked with dark flecks. Lower throat, chest, and sides buffy tinged, streaked with black (heaviest on chest). Belly whitish, unmarked; crissum buff, faintly flecked with brown. Leg feathers mottled, shades of brown.

Brewster (1878:120)

Dwight (1900:204-205)

Ridgway (1901:383)

Miller (1913) Bird-Lore, 15:241.

Forbush (1929) Birds of Massachussetts, 3:Color Plate 72 (opposite page 92).

Roberts (1932) Birds of Minnesota, 2:720 and Color Plate 88.

Sutton (1935:31-33)

Discusses possible geographic variation and color phases.

Pough (1946) Audubon Bird Guide, Color Plate 47.

Passerella lincolni (Plate 37)

M., KU *24748, Alaska, Northway, 17 July, 1947; 59 mm., s. F., GMS (RRG), Colo., Gunnison Co., Aug., 1954; u.

Juvenal Plumage: Forehead rich brown with rather fine black streaks. Median stripe buffy, laterally rich brown, streaked with blackish. Superciliary region gray, finely streaked with blackish. Nape finely mottled, shades of brown, buff, gray, and blackish. Back streaked buffy gray, light brown, and blackish. Rump slightly darker, streaking more obscure. Upper tail coverts and rectrices brownish, black along the shaft. Remiges dark gray; primaries light edged; secondaries, tertials, and coverts edged with rusty. Median and greater coverts tipped narrowly with buff. Tertials blackish with buff tips. Lores grayish. Auriculars rich

rusty brown, margined with blackish; sub-auriculars buff. Chin and throat white, finely spotted and streaked with blackish. Chest, sides, and flanks buff, finely streaked with blackish. Belly and crissum whitish, unmarked. Leg feathers light brown.

Very like adult in every character except plumage texture.

Dwight (1900:203-204)

Ridgway (1901:379)

Miller (1913) Bird-Lore, 15:241.

Forbush (1929) Birds of Massachussetts, 3:98.

Sketch (black and white) of juvenal.

Roberts (1932) Birds of Minnesota, 2:727-728.

Passerella melodia pectoralis

M., GMS 9780, Mexico, D. F., 5 April, 1939; 17 mm., s.

Juvenal Plumage: Crown streaked, blackish and dark brown; nape brown, less black streaking. Back lighter brown heavily streaked. Rump and upper tail coverts unstreaked brown. Rectrices brown, black along shaft. Remiges blackish, primaries and secondaries (part) gray (edged). Coverts and tertials edged with red-brown, secondary coverts tipped with rich buff (two narrow wing bars). Feathers at bend of wing white. Lores, superciliary, and feathers about eye gray buff. Auriculars brown, very dark at margins; sub-auriculars buffy. Chin and throat white, black "mustache" marks at

sides. Lower chest and upper belly region whitish, other underparts rich buff. Chest and sides heavily streaked with blackish, flanks less so. Crissum sparsely marked with dark brown.

Bears closer resemblance to northern Song Sparrows than does adult pectoralis.

Passerella melodia saltonis

F., KU 18554, Ariz., Maricopa Co., 21 June, 1931; 68 mm., u.

Juvenal Plumage: Forehead and crown streaked inconspicuously, pale reddish brown, and cream or light buff. Nape light rusty mottled with buff. Back sparsely streaked, buff, pale rusty, and blackish brown. Rump pale rusty, upper tail coverts rich rust. Rectrices dark gray, edged with rust richly. Remiges and coverts slate gray. Outer primaries light edged; secondaries, tertials, and coverts edged with rust. Secondary coverts light tipped (two narrow buffy white wing bars). Upper tertials blackish, tipped with white. Lores and superciliary cream. Auriculars buffy with rich rusty margins, sub-auriculars buff. Chin and throat white, sparsely spotted with rusty brown at sides. Chest, sides, flanks, lower belly, and crissum buffy; chest and sides streaked with light rusty brown.

Brewster (1878:120)

P. m. melodia.

Dwight (1900:201-202)

See Sutton's (1935) remarks.

Ridgway (1901:355-377)

Comparative notes on many races of this species.

Chapman (1910:71)

See Sutton's (1935) remarks.

Rust (1919:152)

Photo (black and white) of juvenal P. m. merrilli.

Michener (1926) Condor, 28:65.

Photo (black and white) of juvenal P. m. cooperi.

Sutton (1935:33-35 and Color Plate VIII)

Data on P. m. beata. Summary of data presented by others.

Passerella iliaca iliaca (Plate 38)

M., UMMZ *TDB 12918, Newfoundland, 4 July, 1943; 69 mm., s.

M., UMMZ *TDB 13719, Newfoundland, 16 July, 1944; 71 mm., u.

Juvenal Plumage: Forehead, crown, and nape uniform Chestnut. Back rusty buff, streaked with dark Chestnut. Rump and upper tail coverts Hazel. Tail rich Chestnut. Remiges blackish, edged with Chestnut (tertials and coverts broadly edged). Median and greater coverts lightly tipped with buff. Lores and eye-ring buffy white. Side of head concolor with crown, but with small whitish patch behind auriculars. Chin whitish just behind mandible, otherwise dusky red-brown. Throat white, spotted and streaked with dusky-tinged chestnut. Chest, sides, and flanks (less so)

heavily streaked with dusky-tinged chestnut. Belly white, only sparsely marked. Crissum buffy white, obscurely streaked with rusty. Leg feathers uniform chestnut.

Passerella iliaca townsendi (Plate 38)

F., UMMZ *(MMP), Can., B. C., Q. C. Isl., July, 1940; 68 mm.u.

Juvenal Plumage: Forehead and crown uniform dusky brown (nearest dark Chestnut-Brown). Nape grayer. Back and rump similar to crown, becoming more red-tinged toward upper tail coverts. Tail about Chestnut-Brown. Remiges blackish, conspicuously edged (especially tertials and coverts) with rich Chestnut or Chestnut-Brown. Lores, side of head, subauriculars, and sides of chin and throat about concolor with crown (fine buff streaks on auriculars). Underparts buffy or buffy-white, heavily spotted and streaked with dusky Chestnut-Brown (except belly and crissum). Belly much less heavily marked. Crissum rich buff, unmarked.

Similar to adult but without pure white color below.

Passerella iliaca subspecies (Plate 38)

F., UMMZ (Laing), Can., B. C., 17 July, 1940, 23 mm., s.

F., UMMZ *(Laing), Can., B. C., 17 July, 1940; 45 mm., s.

Fleshy Parts: Bill olive brown, lower mandible more yellowish; toes, tarsus pinkish brown (younger specimen), brown (older specimen); gape yellow; soles whitish.

Natal down: Younger specimen has tufts of brown down (whitish basally) on crown and rump.

Juvenal Plumage: Similar to P. i. townsendi, described but lighter in all parts (less dusky). Ventrally, whiter, streaking grayer.

Passerella iliaca schistacea (Plate 38)

M., KU #27836, Idaho, Bonneville Co., July, 1949; 81 mm., u. F., UMMZ #86599, Idaho, Bear Lake Co., Aug., 1935; 80 mm., u.

Juvenal Plumage: Forehead, crown, and nape brown-tinged gray. Upper back more strongly brown or rusty tinged, becoming incriasingly rusty posteriorly. Lower back obscurely streaked with shades of red-brown, and gray. Rump and upper tail coverts (brighter) uniform rufous. Rectrices dark gray, tinged and edged with rusty (middle pair especially). Remiges dark slate gray, edged with rusty. Coverts edged with brighter rust, secondary coverts tipped narrowly with buff (no wing bars). No definite face pattern. Lores brownish gray, auriculars mottled, buff and gray-brown. Post-auriculars like nape. Sub-auriculars, chin, and throat whitish, finely spotted with dusky brown, or reddish-brown. Chest, upper belly, sides, and flanks white, spotted and streaked with dusky red-brown. Belly white, unmarked. Crissum uniform buffy. Leg feathers buffy brown.

Like adult except in feather texture.

Dwight (1900:206)

Ridgway (1901:387 and 395)

P. i. iliaca and schistacea.

Forbush (1929) Birds of Massachussetts, 3:104.

Aldrich (1943) Proc. Biol. Soc. Wash., 56:164.

Proposed race, olivacea, distinguishable from P. i. schistacea in juvenal plumage.

Calcarius lapponicus lapponicus (Plate 39)

F., GMS 11748, Baffin Isl., 10 July, 1953; 8 mm., s.

M., GMS *11750, Baffin Isl., 12 July, 1953; 40 mm., s.

Fleshy Parts: Bill dark gray, eyesdark brown, feet brownish flesh color (11750).

Natal down: 11748 has dusky-tipped white down on sides of head and nape; buffy-tinged white down on wings, rump, and flanks.

Juvenal Plumage: Crown streaked, blackish and light golden brown. Suggestion of buffy white median stripe. Nape streaked, buffy or buffy white and black. Back broadly streaked with black, buffy white, and golden brown. Rump similar but darker (no white). Upper tail coverts black, edged with rich buff. Rectrices black, edged with buff. Outermost rectrix largely white, second from outside whitish on lateral edged. Remiges black; secondaries tipped with buff, tertials broadly edged with rich chestnut and narrowly tipped with white. Lesser coverts black, edged with white. Median and greater coverts edged with rich chestnut (as tertials). Two distinct white wing bars. Lores dusky, eye-ring white. Superciliary light buffy finely streaked with black.

Auriculars buffy, margined with black; post-auriculars whitish (distinct cheek patch). Chin and throat buff-tinged white, spotted and streaked with black. Chest, sides, and flanks buffy, streaked with black. Belly and crissum whitish, unstreaked. Leg feathers buffy, marked with black.

Similar to winter female, but more distinctly streaked and colors brighter.

Calcarius lapponicus alascensis (Plate 39)

? DMNH #9081, Alaska, Wales, 15 July, 1922; 39 mm., s.

Juvenal Plumage: Similar to C. l. lapponicus described but more richly colored throughout. Crown streaked, black and golden brown. Back streaked with black, buff, and golden buff. Chest, sides, and upper flanks rich golden buff, rather finely streaked with blackish. Other underparts buffy-tinged white. Legs buff-tinged white.

Dwight (1900:183)

Ridgway (1901:156)

Chapman (1910:243)

Witherby (1948:148)

C. l. lapponicus.

Calcarius pictus (Plate 39)

M., USNM #167118, Man., Churchill, 24 July, 1900; 42 mm., s.

M., CM #129577, Canada, Mackenzie, 21 July, 1942; 60 mm., s.

Juvenal Plumage: Forehead and crown streaked, black and golden buff. Suggestion of white median stripe. Super-

ciliary white, flecked with dark (extends to sides of nape). Nape white to golden buff, streaked with blackish. Back feathers black, edged with white (upper back), and golden buff (lower back). Rump feathers black, edged with buff. Back pattern scaled (somewhat). Two outermost largely white, the rest dark, edged with light brown. Remiges blackish, edged with buffy white. Tertials edged with rich buffy brown. Lesser coverts black, edged with white. Secondary coverts edged with buffy brown and tipped with white (two white wing bars). Lores golden buff and white. Eye-ring white. Auriculars streaked buff and black, outlined by white sub- and post-auriculars. White spot at posterior margin of auriculars (distinct cheek patch). Underparts (chin to crissum) buff. Chest and its sides streaked with black. Rectrices rather acuminate.

Calcarius ornatus (Plate 39)

? USNM 65651, Souris River, 10 Aug., 1873; 7 mm., s.

? USNM *65661, Souris River, 9 Aug., 1873; 10 mm., s.

M., USNM *259442, N. Dak., Dawson, 26 July, 1915; 55 mm., s.

F., USNM 139044, N. Dak., Steele, 29 July, 1893; 58 mm., u.

Natal down: "Buffy gray down about one-fourth inch long." (Harris, 1944:110)

Juvenal Plumage: Of the two sexed birds, female much more heavily streaked than male. Crown black, streaked with buffy. Suggestion of white median stripe. Nape streaked or

mottled, buffy or buffy white and black. Back feathers blackish edged with white or buffy (scaled back pattern). Rump mottled black and buffy. Tail as in winter birds, two lateral pairs nearly all white; two medians blackish, edged gray-brown; other white, terminated with black. Remiges black, edged with buffy white; tertials and secondary coverts edged with rich buff. Lesser coverts blackish, edged with white (as in all longspurs). Secondary coverts white-tipped (two white wing-bars). Lores buffy or white. Superciliary white, flecked with black; eye-ring white. Auriculars blackish and buff, post-auriculars whitish or buff (distinct cheek patch). Chin, throat, lower belly, and crissum white. Other underparts buffy, chest and sides streaked with blackish. Leg feathers whitish or buff, marked with brown.

Brewster (1878:118)

Description obviously not of juvenal, probably refers to winter plumage. The juvenal back pattern is not streaked, and its color is not "reddish brown," but black.

Dwight (1900:184)

Ridgway (1901:162)

Chapman (1910:243)

Mentions similarity of appearance of juvenals of Ammodramus savannarum to those of this species.

DuBois (1937) Condor, 39:106.

Brief, on natal down and fleshy parts of nestlings.

Harris (1944) Wilson Bull., 56:110-112.

Data on down, its distribution; development and natural history of nestlings.

Rhynchophanes mccowni (Plate 39)

F., DMNH *13570, Colo., Weld Co., 8 Aug., 1936; 53 mm., s.

M., DMNH *13572, Colo., Weld Co., 8 Aug., 1936; 52 mm., s.

? DMNH 18204, Colo., Weld Co., 17 July, 1937; 12 mm., s.

F., DMNH 13569, Colo., Weld Co., 8 August, 1936; 41 mm., s.

Natal down: Light, buff-tinted white down on side of nape, on wings and rump (18204).

Juvenal Plumage: No apparent sexual dimorphism, though individual variation in darkness of back and amount of ventral streaking. Forehead buffy white. Crown blackish brown, feathers edged with buffy-white. Nape largely buffy white, mottled with blackish. Back and rump black, each feather edged with buffy-white (scaled back pattern). Longest upper tail coverts brown edged in buff. Rectrices acuminate. Outermost largely white; others white broadly tipped with black (as in adults), except two median rectrices blackish. Primaries and secondaries blackish, edged and tipped white. Tertials brownish, tipped with white, edged with buff. Coverts blackish, edged with buff. Secondary coverts form distinct buffy wing patch bordered by two buffy white wing bars. Lores, eye-ring, and superciliary buffy white. Auriculars and post-auriculars mottled, dusky and buff. Subauriculars, chin, and throat white. Chest, sides, and flanks

light buff. Chest and its sides spotted and streaked with blackish. Belly and crissum white. Leg feathers buff-tinged white.

Ridgway (1901:165)

Chapman (1911:17)

Roberts (1932) Birds of Minnesota, 2:709.

Rhynchophanes largely white on underparts, not easily confused with juvenals of C. ornatus as is suggested.

DuBois (1937) Condor, 39:237.

Brief, on down, nestling development, and juvenal plumage.

EXPLANATION OF PLATES

The following photographic plates are intended to supplement descriptions presented, and to illustrate certain points made in the thesis. In some cases they may prove helpful in identification of juvenal specimens.

Unless otherwise indicated the specimens shown are in juvenal plumage or in very early stage of the postjuvenal molt. A dorsal and ventral view of each is shown. The caption always indicates specimens from left to right. Often more than one specimen of a kind is figured to show individual or age variation. If more than one specimen of a kind is shown, the number is given. Sex of specimens is given only if sexual dimorphism is apparent. Geographic variation is indicated either by the subspecific epithet or by a locality name.



Plate 1. Hesperiphona: vespertina (male, female); abeillei (females).

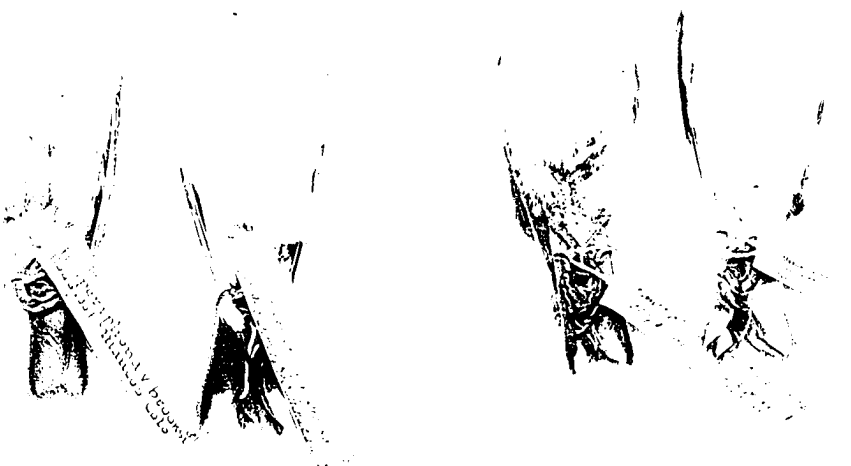




Plate 2. Carpodacus: purpureus californicus (2), p. purpureus (3); cassini (3).



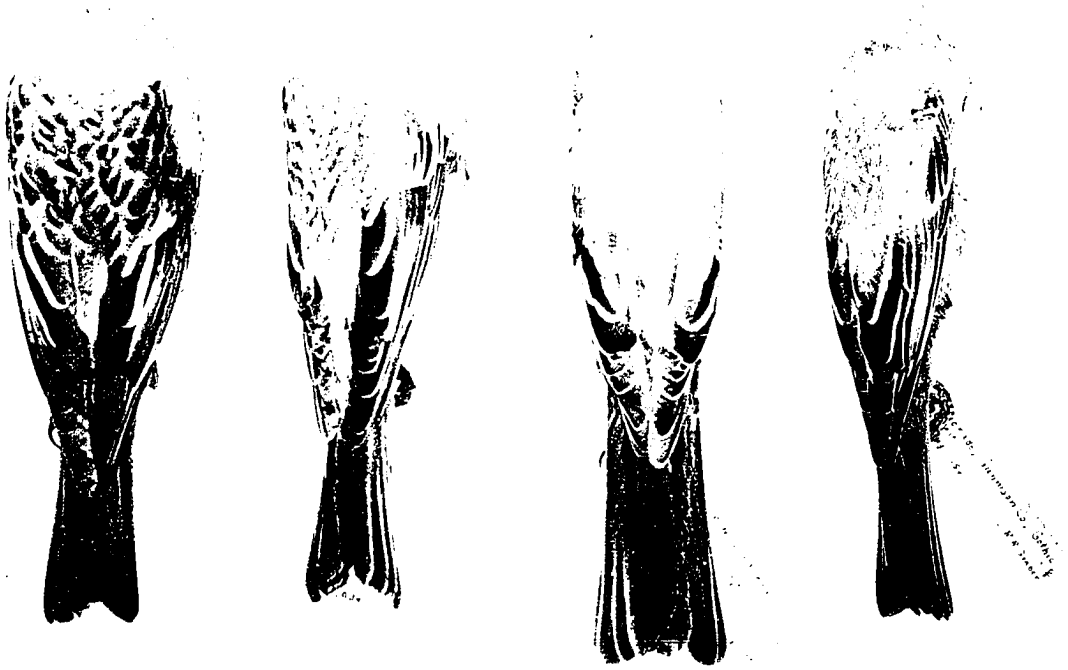


Plate 3. Pinicola: adult male, female; juvenals (2).



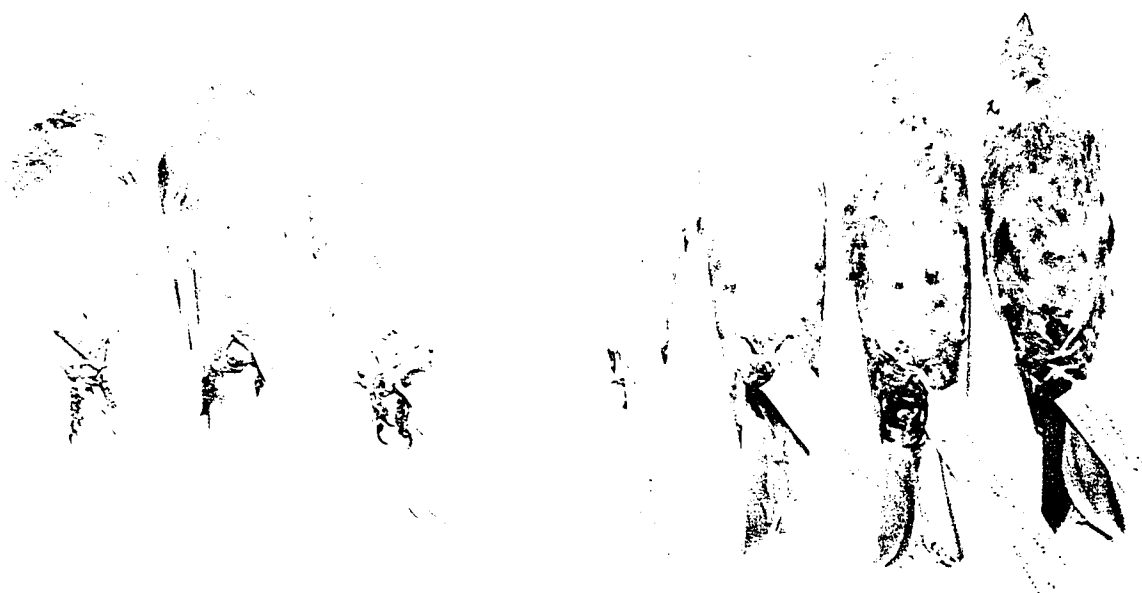


Plate 4. Leucosticte: griseonucha (2); tephrocotis littoralis, t. dawsoni (3).





Plate 5. Leucosticte: atrata (3); australis (4).



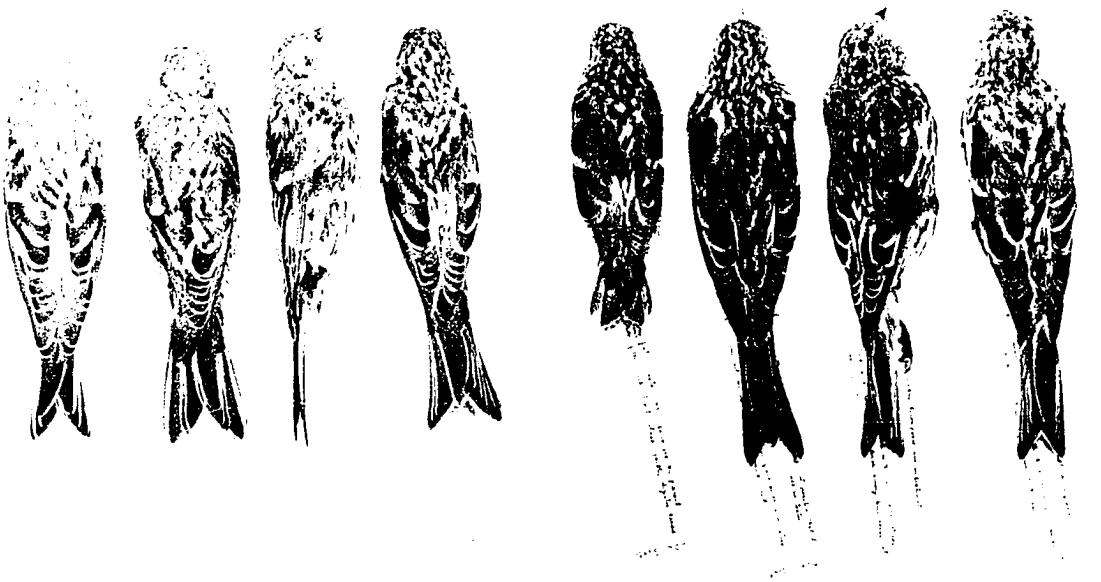


Plate 6. Acanthis: hornemanni (4); flammea (4).





Plate 7. Spinus: tristis (2); psaltria (2); notatus; pinus; atriceps (2); lawrencei (2).



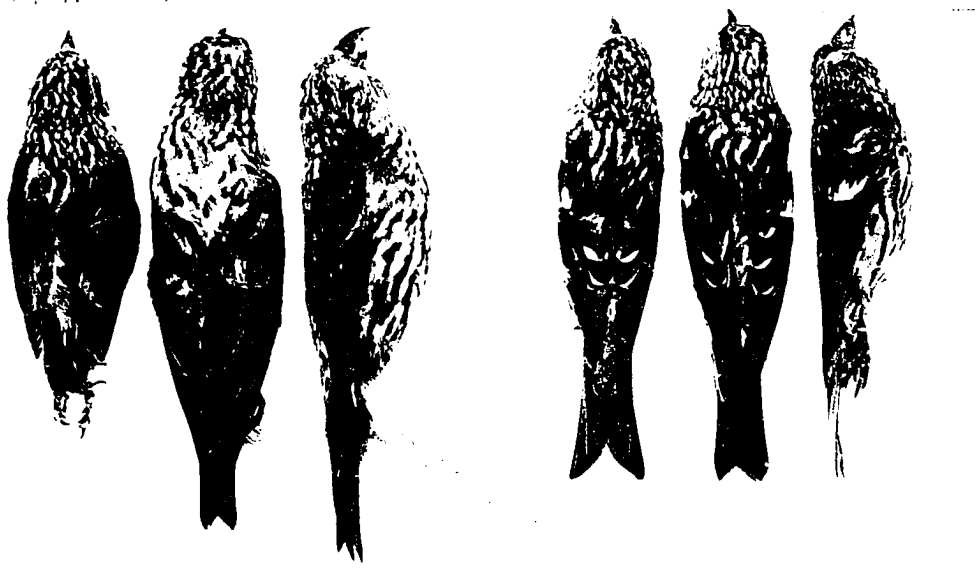


Plate 8. Loxia: curvirostre (3); leucoptera (3).



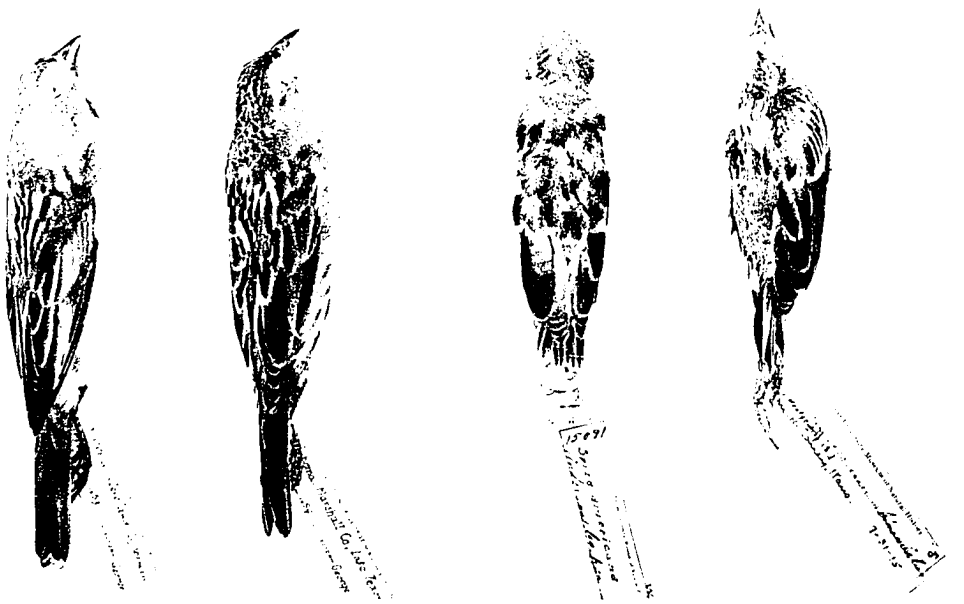


Plate 9. Spiza: adult male; immature; juvenals (2).





Plate 10. Richmondena: cardinalis (2); phoenicea (2). Pyrrhuloxia (2).





Plate 11. Guiraca: adult male, female; juvenals (2).





Plate 12. Pheucticus: ludovicianus (female, male); melanocephalus (2); chrysopeplus.





Plate 13. Passerina: ciris (2); versicolor (2); leclancheri; rositae; amoena; cyanea.

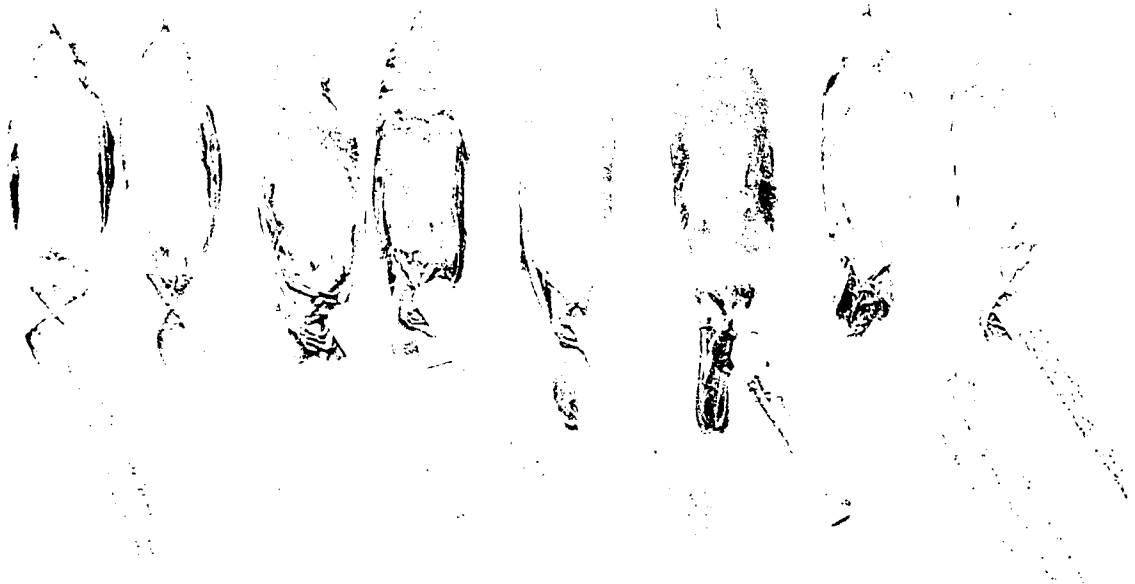




Plate 14. Plectrophenax: Baffin Island specimens (3), Alaska specimen.

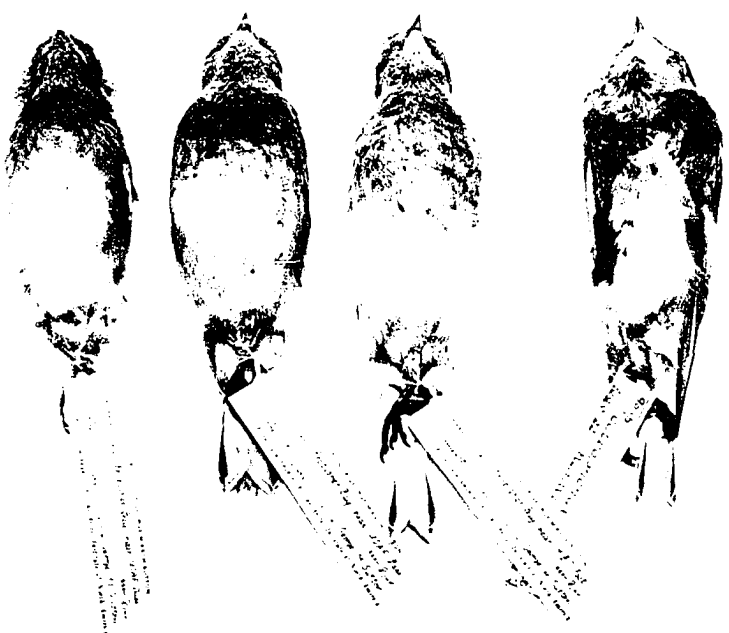




Plate 15. Sporophila torqueola: juvenals (2); adult female; immature male.



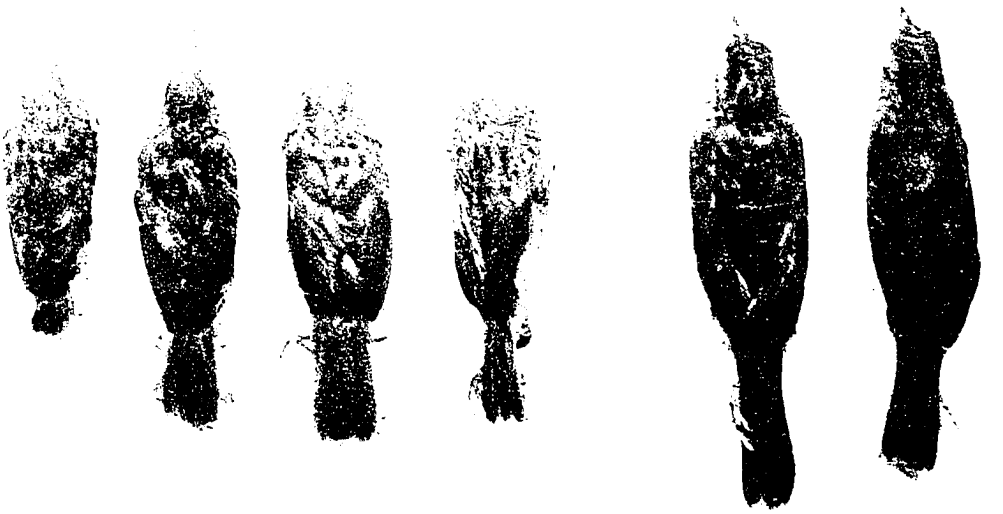


Plate 16. Arremonops: rufivirgatus (4); conirostris conirostris, c. umbrinus.



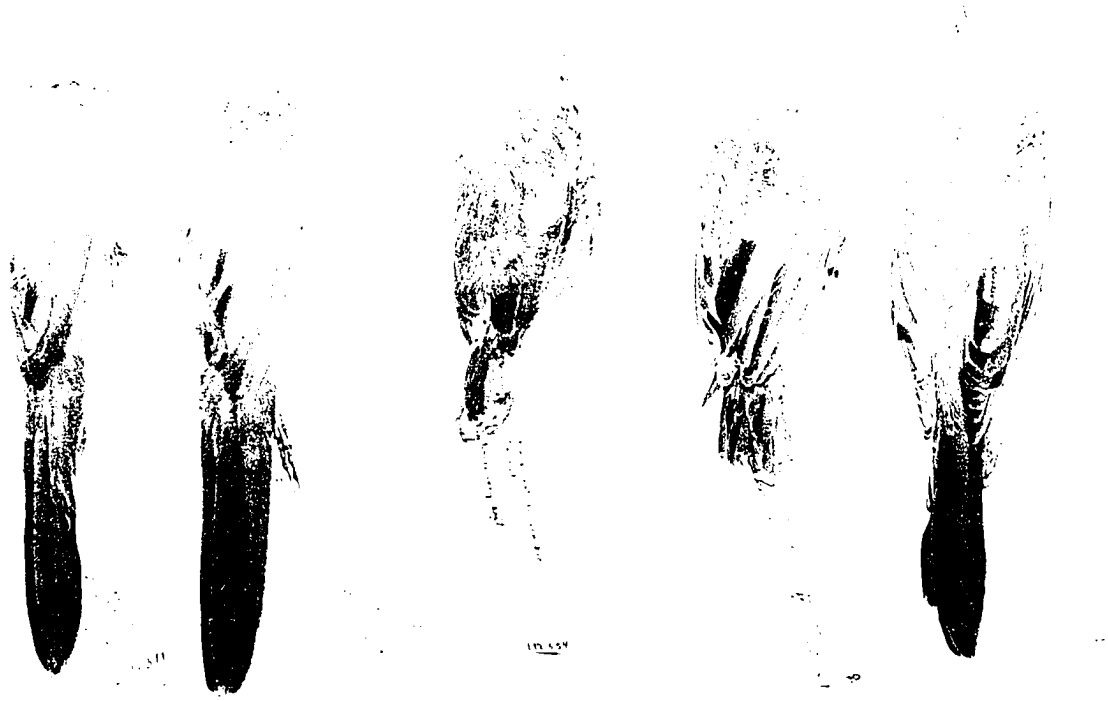


Plate 17. Pipilo: aberti (2); fuscus fuscus, f. mesoleucus (2).





Plate 18. Pipilo: erythrophthalmus montanus (male, female); e. erythrophthalmus (female); ocai. Chlorura (2).

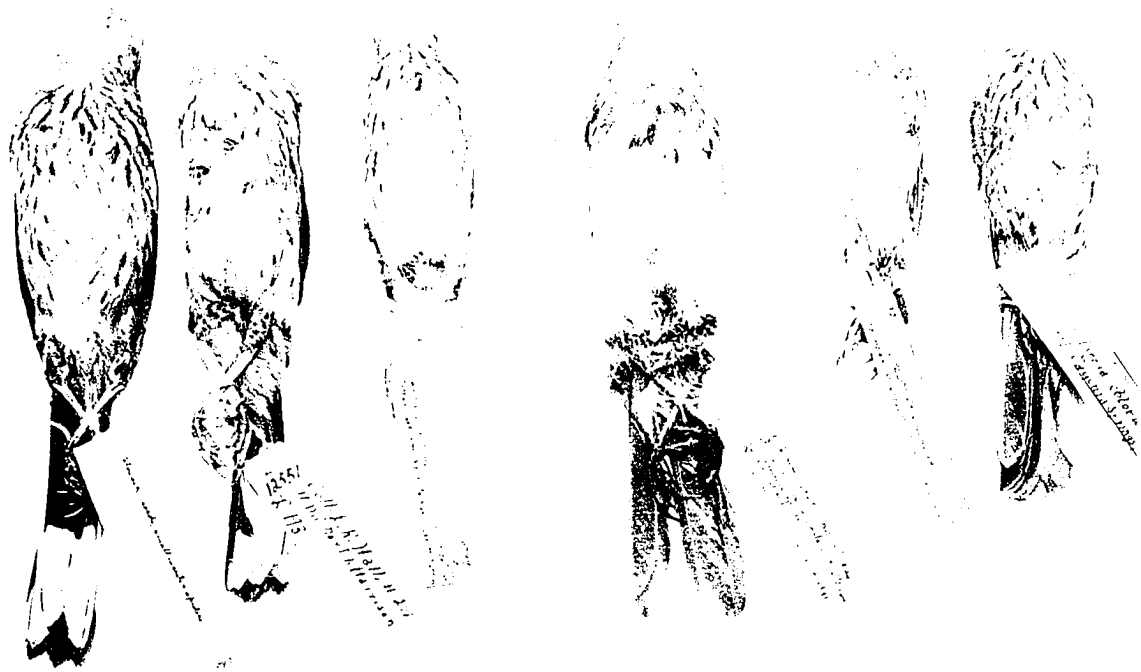




Plate 19. Calamospiza: juvenals (2); adult female.





Plate 20. Passerculus: sandwichensis alaudinus (3), s. savanna (4).





Plate 21. Ammospiza: caudacuta subvirgata (male, female); c. nelsoni (2 males, 2 females); lecontei (2 males).

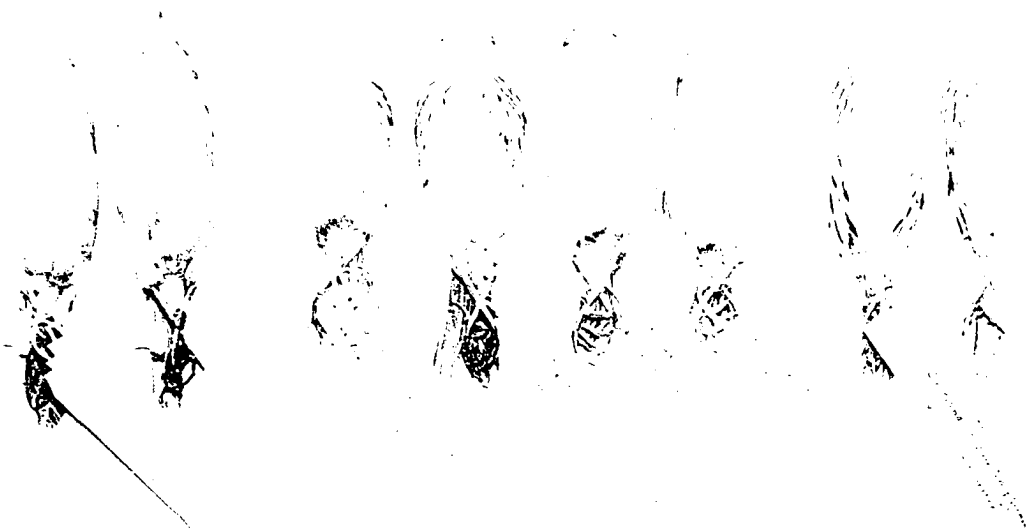




Plate 22. Passerherbulus (2); Ammospiza lecontei.



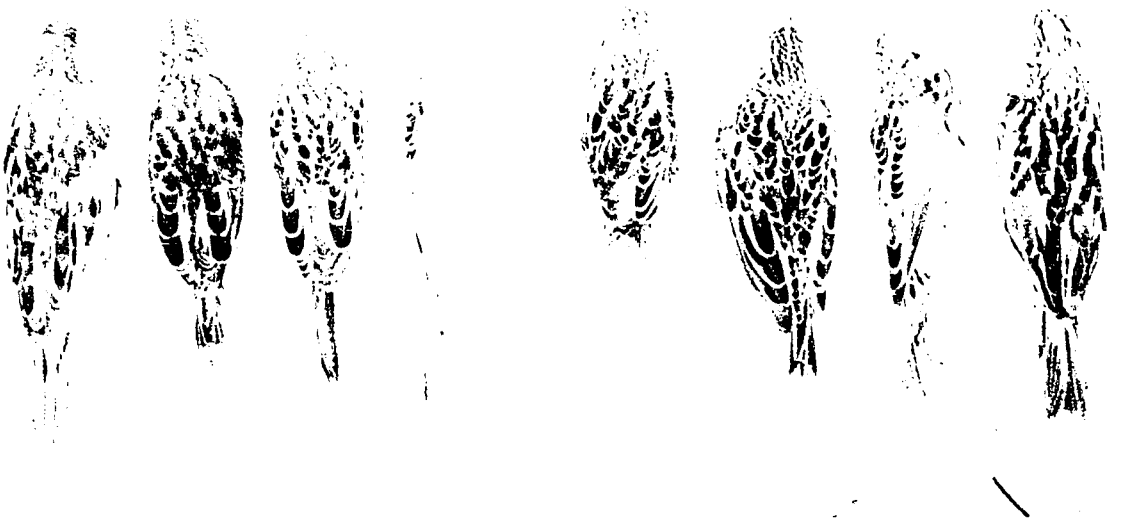


Plate 23. Ammodramus: savannarum (adult, 3 juvenals); bairdi (3 juvenals, adult).





Plate 24. Pooecetes: gramineus affinis, g. confinis (2), g. gramineus.





Plate 25. Chondestes: juvenals (2); specimens in postjuvenal molt (2); adult.





Plate 26. Aimophila: aestivalis (2); botterii; cassini (2); carpalis (2); mysticalis; humeralis.





Plate 27. Aimophila: ruficauda (2); sumichrasti; ruficeps (2); rufescens (2).





Plate 28. Amphispiza: bilineata (2); belli.



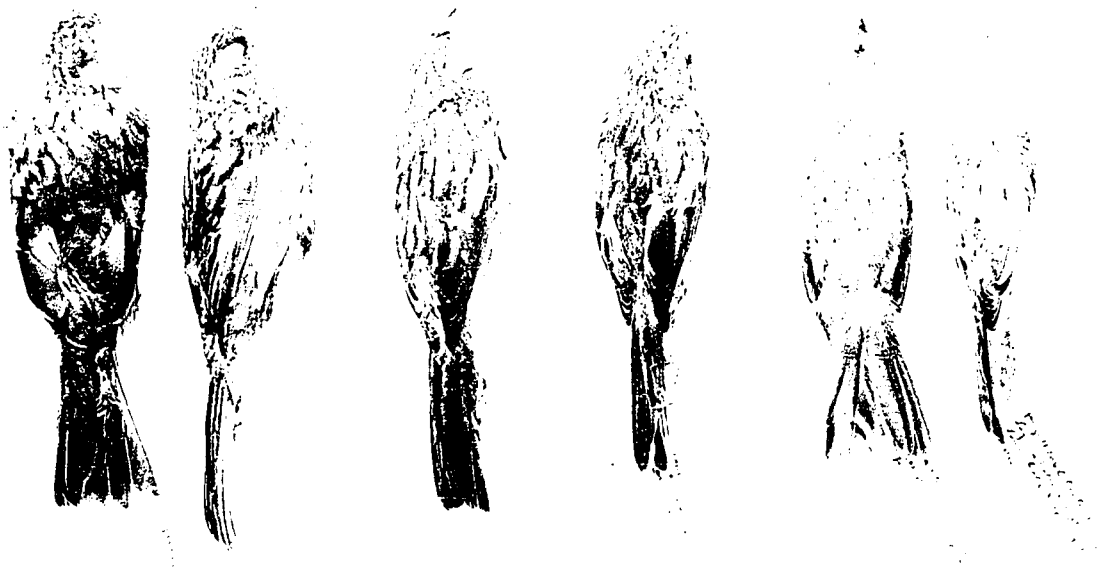


Plate 29. Junco: vulcani (2); alticola; fulvescens; bairdi (2).

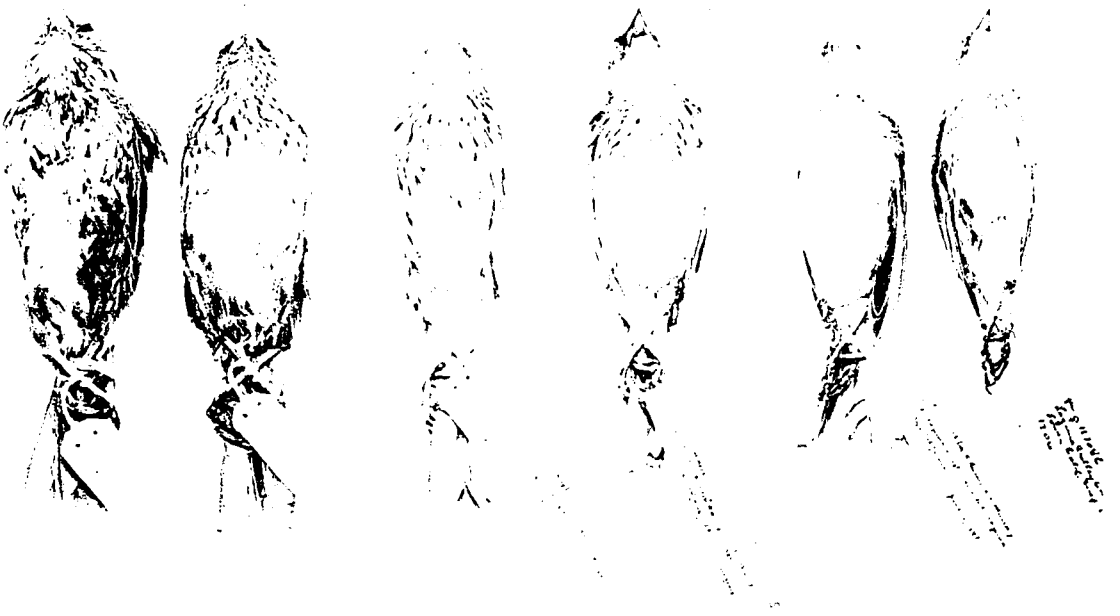


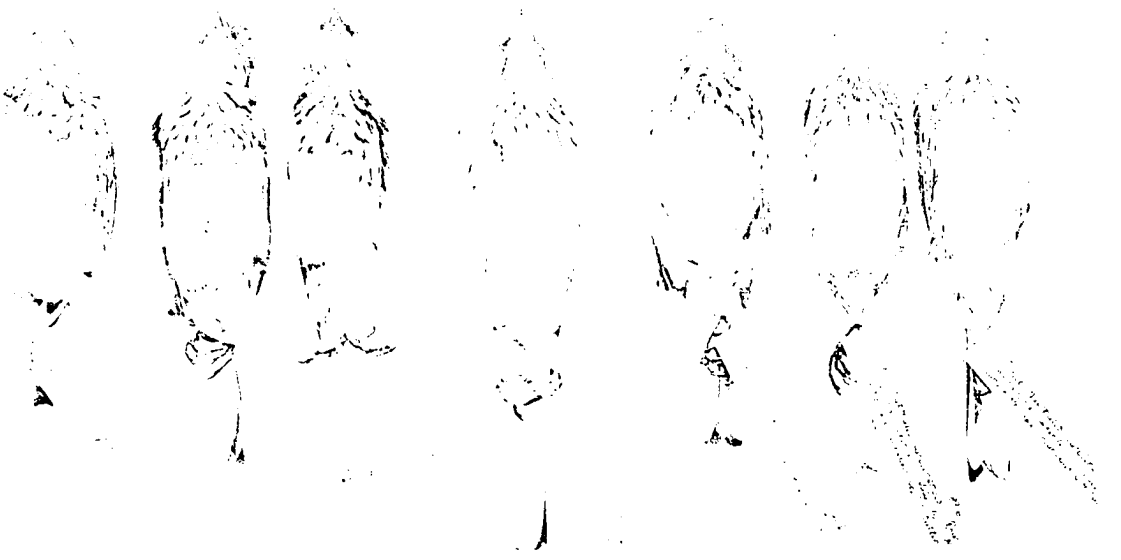


Plate 30. Junco: fulvescens; phaeonotus (4); caniceps (3).





Plate 31. Junco: oreganus (3); aikeni; hyemalis (3).



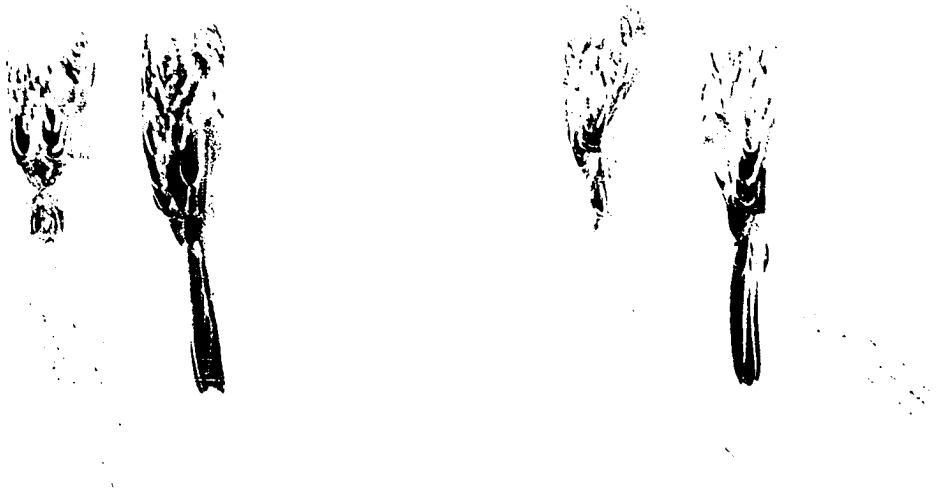
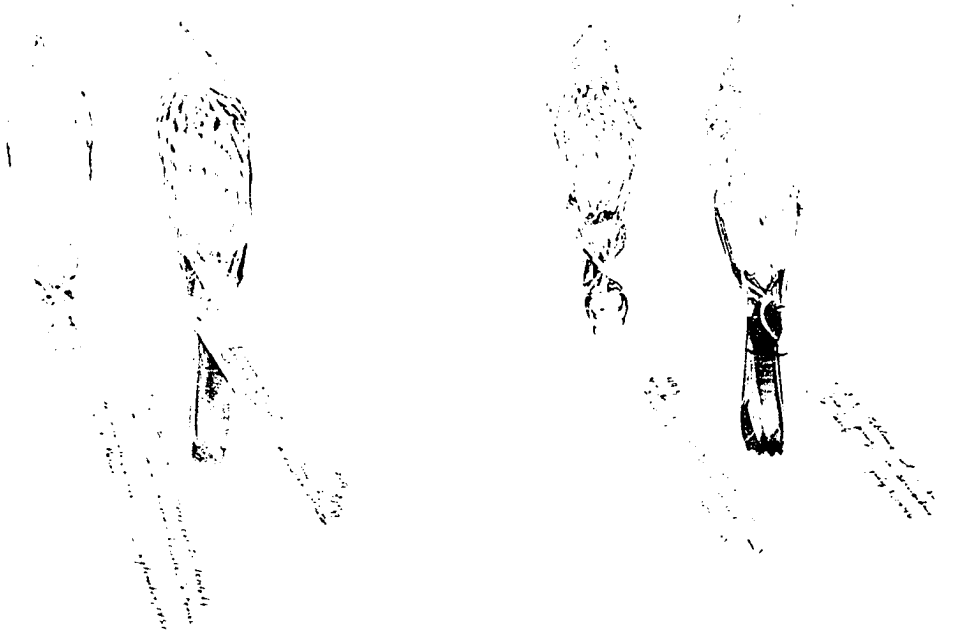


Plate 32. Spizella: pusilla (2); atrogularis (2).



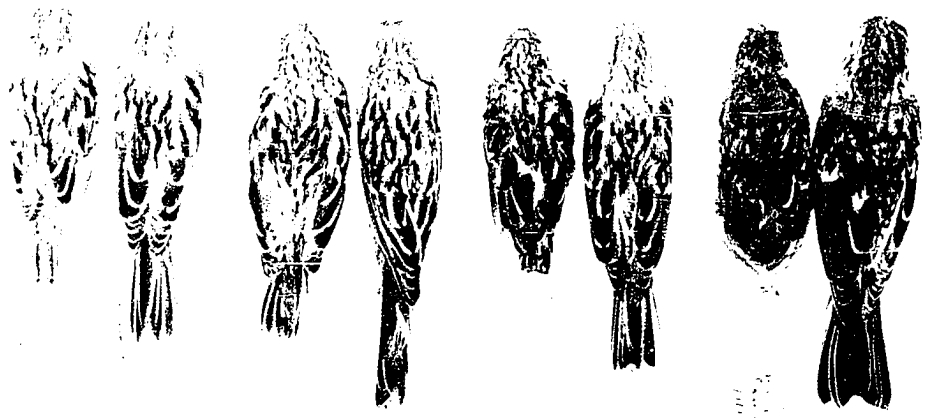


Plate 33. Spizella: pallida (2); breweri (2); passerina (2); arborea (2).



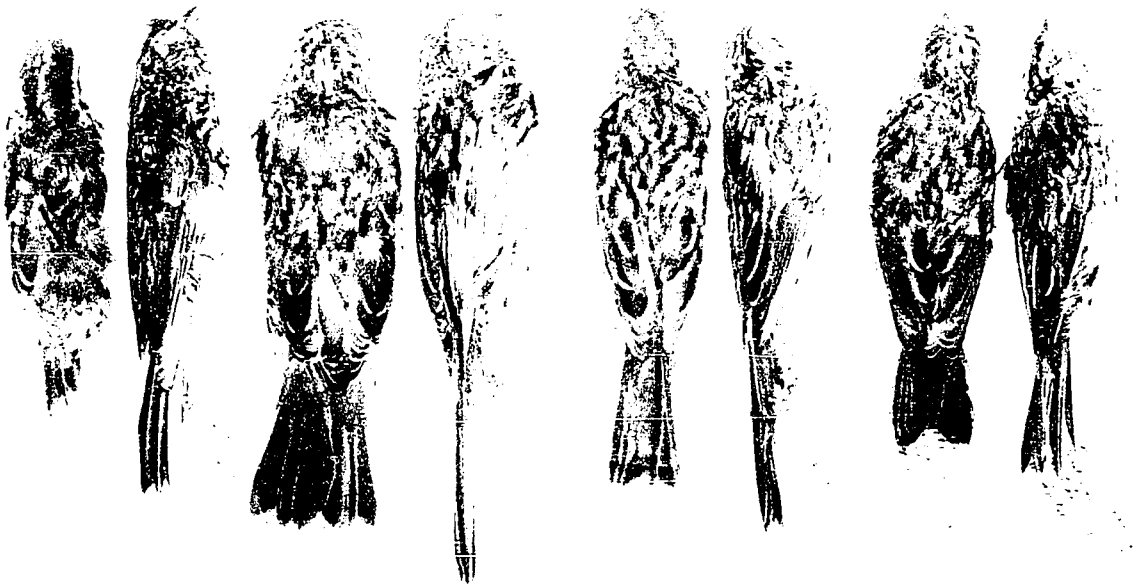


Plate 34. Zonotrichia: albicollis (2); querula (2); coronata (2); leucophrys (2).

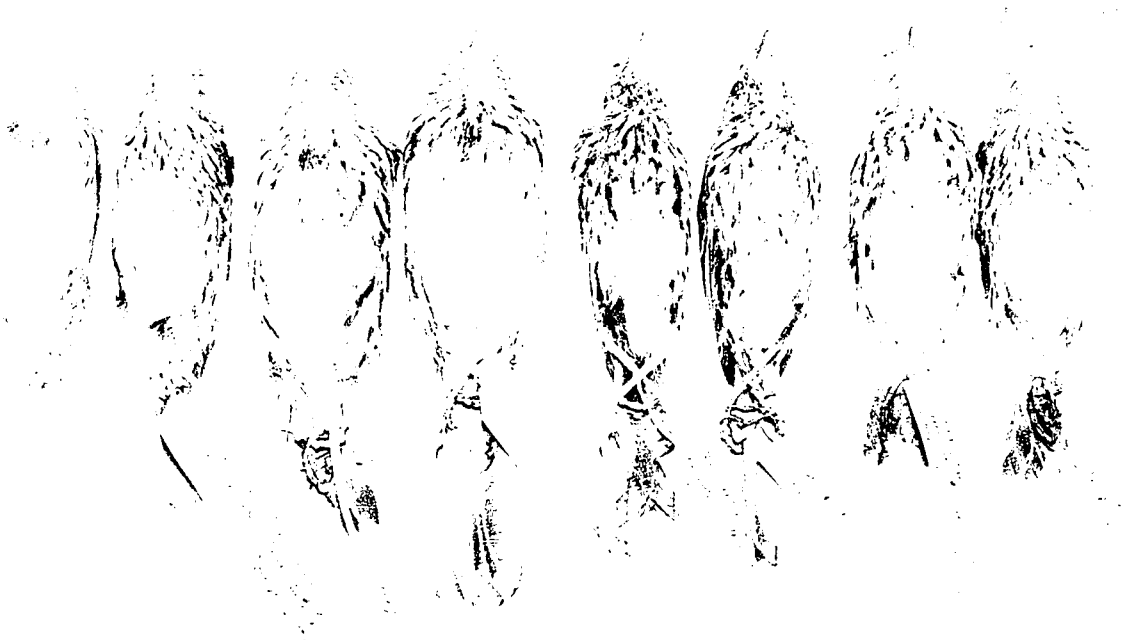


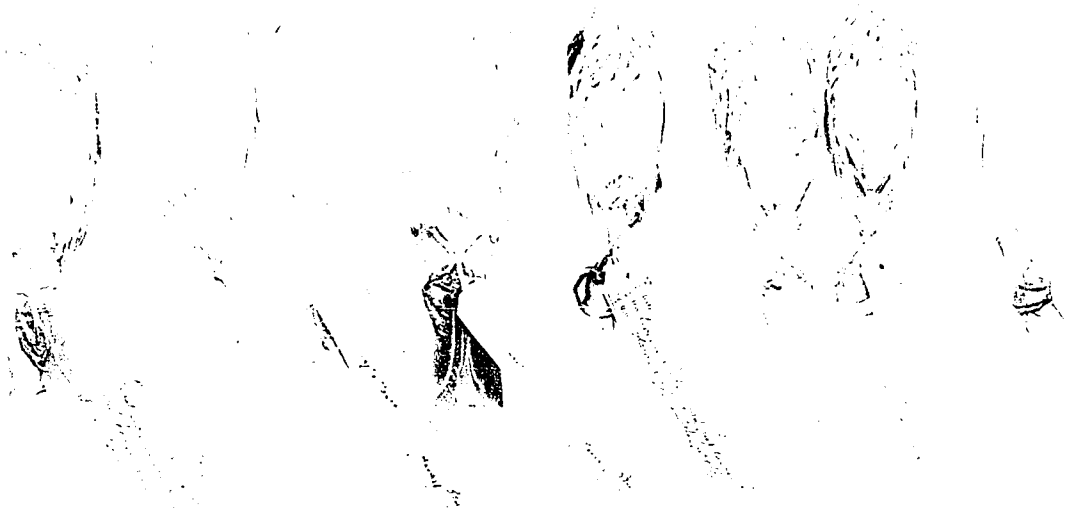


Plate 35. Zonotrichia querula: adults (2); immatures (2); juvenals (2).





Plate 36. Zonotrichia: leucophrys; capensis chilensis (3); c. peruviana (3); c. insularis.



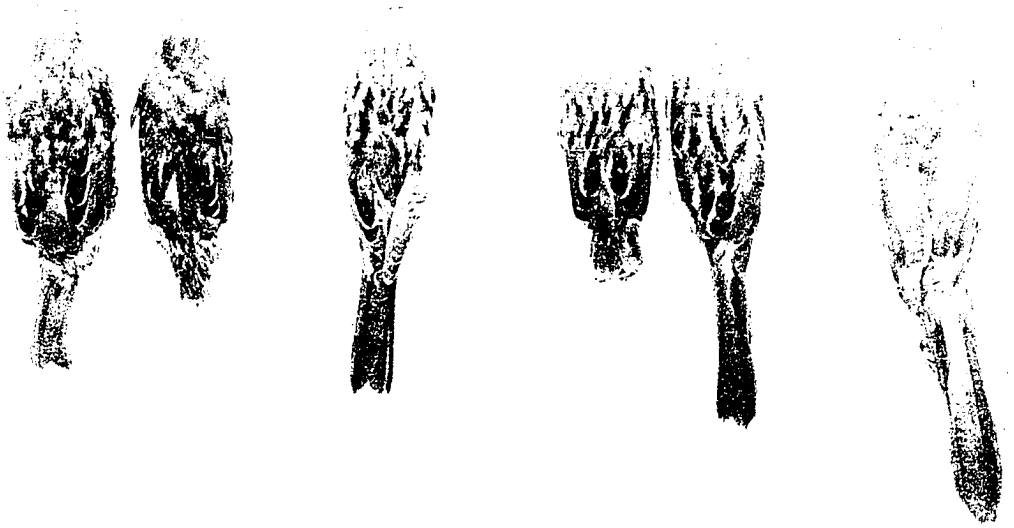


Plate 37. Passerella: georgiana (2); lincolni; melodia (2); iliaca.

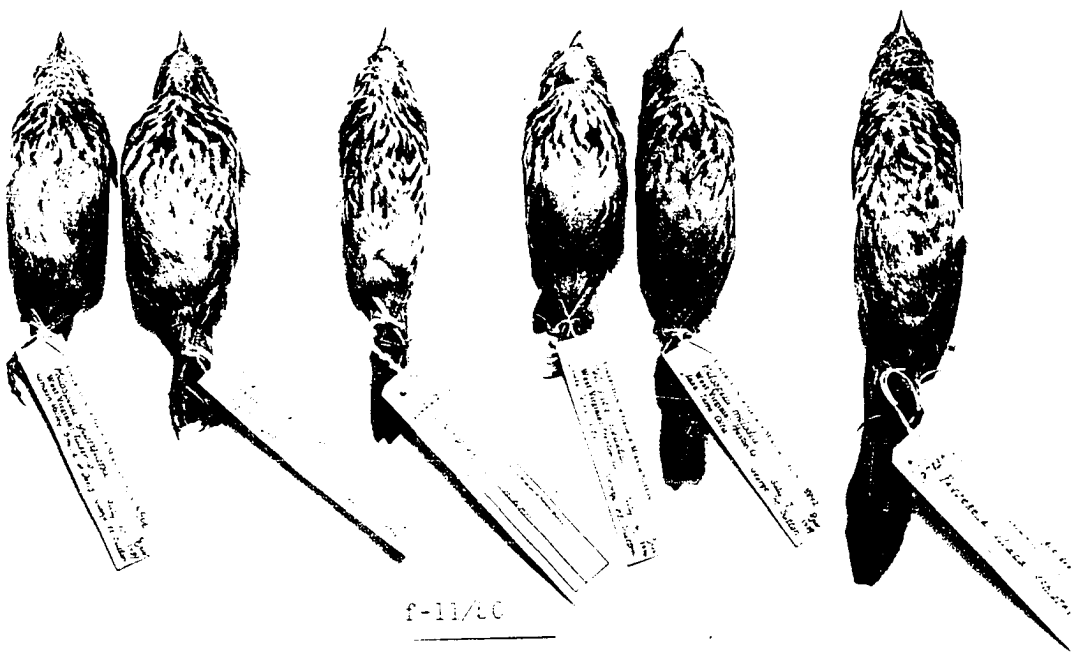




Plate 38. Passerella: iliaca townsendi; i. subspecies?; i. schistacea (2); i. iliaca (2).





Plate 39. Calcarius: lapponicus (2); ornatus (2); pictus (2). Rhynchophanes (2).



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R. R. Garber

Photostats in this thesis have extremely small print in places. This fades out and is unreadable especially in the photostats that have picture of birds with tags on them. Identifying data on these tags cannot be read.

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