

# SEX AND AGE DETERMINATION OF RED CROSSBILLS

## (*Loxia curvirostra*)

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General opinion and most of the extensive North American literature state that adult male Red Crossbills (*Loxia curvirostra*) are red-bodied; that females, after molting the streaked juvenal plumage common to both sexes, are grayish olive mixed, at least on the rump, with yellowish; and that immature males are variably intermediate between these two extremes. It has been suggested that some males require two or more years to become fully red, and that some old females become brighter, but never markedly reddish. Most of these ideas require emendation. Better criteria of determining age and sex became necessary when I found an unsuspected degree of size variation due to sex and age, particularly in the larger races; immature females of one may be as small as adult males of a smaller race. Specimens of unknown or incorrectly determined sex posed a hazard in identification.

### METHODS, MATERIALS, ACKNOWLEDGMENTS, AND ABBREVIATIONS

Conclusions on age determination, especially, were based initially on my own dissections over many years and my more limited studies of borrowed skins in 1957. They were modified and extended by examination of the majority of the Red Crossbills ever collected in North America, particularly the eastern and southwestern United States, plus others from Eurasia. These recent (1970-1975) studies were conducted mainly at the American Museum of Natural History (referred to below as AMNH), the British Museum (Natural History) (BM), the Delaware Museum of Natural History (DEL), and the Royal Ontario Museum. The authorities of these museums very kindly assisted in various ways, including the handling of numbers of loans of specimens, since a great many other museums (and persons) lent me either selected specimens or their entire series. Several other major series were examined *in situ*. Thus very few important North American collections, public or private, were not seen by me, at least in part. I have seen all the important material seen by the last reviser (Griscom, 1937), plus a much larger amount (especially from the western United States and the areas around the Great Lakes) not examined by him, much of it collected since 1937. I, too, concentrated on the races and their distributions and amazing flights; biological (and plumage) notes were rather incidental until my final (1974-1976) studies. Nonetheless it is only proper to acknowledge here my great indebtedness to a vast number of patient colleagues in several countries, including many ornithologists in North America. To name them all, alas, would fill many pages in this journal! To all I extend my thanks and my apologies. The Frank M. Chapman Memorial Fund of the American Museum of Natural History supported my visits to Europe.

"ARP" refers to my original field catalogue of specimens personally collected. I also refer below to the Amadeo M. Rea col-

lection (AMR), Denver Museum of Natural History (DEN), Grand Canyon National Park collection (GCN), University of Kansas Museum of Natural History (KANU), Los Angeles County Museum (LAM), Museum of Comparative Zoology at Harvard University (MCZ), University of Michigan Museum of Zoology (MICH), Naturhistorisches Museum in Wien (NMW), Oregon State University, Corvallis (OSU), Princeton Museum of Zoology (PMZ), collection of Roger Tory Peterson (RTP), and United States National Museum of Natural History (US). To aid in locating the specimen involved, its size-class is usually cited, by Roman number (e.g. III) agreeing with my forthcoming revision (Phillips, in prep.), since the Griscom - A.O.U. names of subspecies are more confusing than helpful (they are mentioned in quotation marks in some cases). Size I is the smallest, IV largest, of United States birds; measurements of IV, I, and III, in that order, may be found in Phillips 1975:78.

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#### AGE AND SPECIES DETERMINATION

A better character than general body coloration to distinguish adult from immature males, advanced mostly in the European literature (e.g. Witherby et al, 1938:97; cf. also Tordoff, 1952), is the edgings of the outer webs of both primaries and rectrices; these are usually dull reddish in adult males, not olive to dull whitish as in immatures. Even this characteristic, however, must be used with caution. Males with rich red-edged primaries, to be sure, have at least acquired some primaries of a second set; but they may occasionally still be quite young (see ARP 3523, below), and even in the wild some adult males have grayish to drab edgings (see "Variations in male colors," below). Furthermore, red-edged flight feathers sometimes do appear, presumably as early replacements, in young males, most often in the central part of the tail; and moderate wear is common and will obscure the colors of these edgings. (Caged crossbills, of course, commonly turn yellow.)

If the color of primary edgings were simply dependent on age, the appearance of red-edged primaries among the olivaceous ones should result from accidental losses of feathers. This may often be true, but is apparently not invariable. For example, DEL 46020, a III from Idaho, has most of the edgings reddish in the median part of the tail, but also has primary no. 5 red-edged, symmetrically (i.e. in both wings); no. 4 seems to show a vague hint of reddish distally in the left wing, but all the other edgings are grayish (inner primaries) to very pale, dull olivaceous. Obviously this male cannot be aged by these edgings, but the pale edgings of certain primary-coverts indicate that it may be immature.

Reddish (to deep hepatic or liver-red) edgings to the outer webs of the feathers of the alulae, primary coverts, and all the greater secondary coverts are good marks of an adult male. Immatures, if unworn, show at least a little distinctly pale edging, externally, on the distal part of about the fourth primary covert from the outside,

if not also the inner primary coverts; all these are dark, or have very narrow, inconspicuous pale edgings in most adults. Immatures never show pronounced reddish tones in the primary coverts.

In North America long, dark shaft-streaks, reaching the tips of the feathers of the posterior median underparts (breast, belly) show the retention of juvenal plumage. So, ordinarily, do indications of wing-bars—whitish or pale tips, or distal external edgings, to any of the greater secondary coverts (most frequently the inner coverts, or the outermost). But wing-bars seem rare in females generally, and in both sexes of our smallest races, size I, "*sitkensis*" *sensu* A.O.U. (In parts of Eurasia the above characters are *not* limited to juvenal feathers.) The narrower, more pointed rectrices and primaries of immatures are average characters of little practical use even when good series are available.

An occasional immature shows conspicuous whitish edges and tips to the tertials, as well as wing-bars. These exceptional birds point up the need to note the *breadth* (until worn) and clear whiteness of the "wing-bars"—particularly the anterior bar, but also the inner part of the posterior bar—of the White-winged Crossbill (*Loxia leucoptera*) whose wing-bars are its true specific character. Particularly close approaches to the wing-markings of *leucoptera* are shown by a III ("*benti*"), GCN 21070 ♂; a large-billed *japonica*, BM 83.3.29.12; and a ♀ "*anglica*" from Warnford, Harts., 14 Dec. 1929 in the Meinertzhagen Collection, BM. Somewhat lesser, though still marked, approaches are shown by another ♂ III, LAM 14381, and a ♂ IV (*stricklandi*), MICH 166,163 (see also Mauersberger, 1976 (Abb. 1) ).

Many immature Red Crossbills that lack tertial-edgings do have wing-bars, but these are narrower, duller, and usually overlooked. Indeed Griscom (1937:113) stated that, of 2,447 American specimens examined: "nor does a single bird possess wing-bars", although in fact these are well shown by his own type specimen of *L. c. bentii* (among many others)! New England ♂ II showing white wing-markings include MCZ 211010, -102, -211, 226279, and 323124.

North American adults have at most a trace of a white wing-bar; e.g. in at least the left wing of a ♂ I ("*sitkensis*"), OSU 7800, two adjacent inner greater secondary-coverts have white tips. (These coverts are largely missing in the right wing.) Other adults showing traces of wing-bars are two ♂ II (MICH 68254; PMZ unnumbered, New Mexico, 8 Nov. 1916, approaching III).

Still many specimens show neither juvenal feathers nor red wing-edgings, and their age remains dubious. Condition of the skull is very important, as shown below, but the gonads are unreliable as indicators of age. Many of the known breeding specimens are immatures, including most of the females shot from nests. A male II from Washington marked "breeding" is about one half juvenal-plumaged (US 378,478). A series of immature I from Idaho (4 Sept. 1971) dissected by me all had somewhat to greatly enlarged gonads, although most retained much of the juvenal plumage; the skulls are not yet cleaned, but most appear unossified. Four of the five ♂♂ had at least one testis from 4.0 to 5.8 mm long, a large size for so small a bird. Of the 3 ♀, two had enlarged follicles,

to 1.0 mm in one and 1.8 mm in the other, and the oviduct of the first was evidently used (I made no note on the other); both retained juvenal feathers on the flanks, upper tail-coverts, and of course median underparts. The third had a bare belly, greatly swollen oviduct, and three or more corpora lutea.

Equally extraordinary is the speed with which some young go through a series of plumages. ARP 3523, a male III taken 6 Sept. 1954, retains both large skull "windows" and some juvenal plumage, chiefly on the belly but also traces on the neck and elsewhere; yet it is already molting from its worn, red, adult-looking body plumage, and acquiring red-edged primaries.

Such cases may result, in part, from a protracted rate of skull ossification. But I cannot confirm that, in any *Loxia*, "the foreparts of the frontal bones of the skull never assume the usual two-layered passerine character" (McCabe and McCabe, 1933:136). This statement is based on "flat skins of . . . four completely red males," of which no. 1086 showed, anteriorly, "no evidence of two layers or of cleavage," whereas 1081 and 1082 had the layers "closely adherent, separable with the aid of a fine-pointed blade . . ." (they also cite an orange male, "single and without perceptible cleavage").

Unfortunately I find poor agreement between the McCabes' statements on their "eleven flat skins" and the actual specimens (MCZ). All three of the above "completely red" males have juvenal flight feathers (except where tail molt has begun); 1081 has juvenal alulae, primary coverts, the outermost greater secondary covert (in each wing), and part of the flanks laterally, being pink elsewhere. The McCabes can hardly have glanced at their prize exhibit, no. 1086; far from being "completely red," it is only *partly dull reddish*. Hepatic to dull orange-reddish colors are limited to the middle portions of the tract on the interscapulars, rump, and sides; the lateral portions of these, the entire flanks, and probably most or all of the chest are still juvenal-plumaged. (The chest is hard to judge in a flat skin.)

Thus, although the *rate* of pneumatization may vary, the process is apparently similar in crossbills and other fringillids. The McCabes' conclusion "that *thinness and transparency* [italics theirs], not singleness, are the criteria" is unsupported by my researches, despite its occasional citation by others (e.g. Tordoff, 1952:200-201). Skull ossification is just as important and useful in aging crossbills as in most other oscines.

#### SEX DETERMINATION

Females are best recognized, in most American races, by the dull, pale grayish to whitish *throat*, which is often more or less *spotted* or mottled with fuscous posteriorly, where it commonly contrasts sharply with a yellower (or more olive) chest. The smallest (I; "*sitkensis*") females, however, often have the throat invaded medially by the color of the chest. These females usually have the chord of the unflattened wing 84 mm or less and the mandible 8.6 mm wide, or narrower. The width is measured transversely from

below, from the point where the mandible enters the skin. But even in these yellow-throated females, the yellow is restricted anteriorly; below the eyes, and from there forward, it is confined to a narrow median patch, covering neither the sides of the throat nor the chin. Females from Sitka itself seem especially deceptive (AMNH); they are unusually rich, ochraceous yellow. None of the few specimens shows the reddish blotches of local males, but partially reddish females do occur near Sitka (US).

In all, or nearly all, males that have undergone the first prebasic molt, the throat is bright. If not yellow to red, it is at least strongly washed with the red or yellow of the chest, not contrastingly duller nor spotted. If contrast shows, it is of a yellow or pink throat against a red chest; dull grayish is restricted to the chin and vicinity, perhaps extending *narrowly* back along the inside of the malar area. Many males, too, are of a brighter, clearer red than any female; some of them are immatures, as pointed out by Brown (1883) and Tordoff (1952). About 40% of an excellent series (DEN) of immature male III ("*benti*") are bright red-bodied, as compared to some 80% of adults; even the other 20% of adults usually shows only minor amounts of yellow. (These figures, of course, exclude as irrelevant the parts of the head, mainly the throat, that commonly become yellow in red males at the prealternate molt early in the year, in most races.)

When direct comparisons are possible, nearly all females are also distinguishable from yellow males by duller colors, particularly on the crown. Here most males are a brighter yellow, less olive-tinged, or as Griscom (1937:111) writes, "more saffron, less greenish yellow." This produces a marked contrast to the color of the back; the edgings of the interscapular feathers are much duller, less orangish or yellow, than the crown in these males.

#### VARIATIONS IN FEMALE COLORS

Two small (I) females taken at Lawrence, Kansas, 26 Nov. 1887 (A. O. Garrett) and 8 March 1951 (Tordoff) are probably immatures (KANU), the first certainly so; its pink patches and tinges are near Cinnamon-Rufous of Smithe (1975), but paler and still brighter. Tordoff's female is pale Ferruginous on most of the rump and liberally mixed below with this color. It is hypoxanthic; in fact the expression of pink or reddish hues in females is often linked to (or enhanced by) dilution or suppression of the usual yellowish tones, and is actually much commoner in *immature* (first basic) than in adult females! An orange-pink admixture may even occur, however, in the rump of the least yellow (grayest) of all crossbills, *L. c. poliogyna* (BM 1930.7.4.14, with sketch of adult-looking ovary by Adm. H. Lynes).

A few females of larger American races show dull reddish colors approaching the above Kansas females. In addition, a Maine immature female (II, "*neogaea*"), 14 Jan. 1882 (RTP), is much mixed with pale Tawny. One from Tamaulipas (IV) taken by Paul S. Martin (DEL) varies slightly toward Ruby from Ferruginous. In terms of Ridgway (1912), as determined at AMNH, a

female III ("benti," DEN 23740) is near Apricot Orange. Most variant females, of course, are less extreme reddish, more dull pinkish orange or ochraceous, in limited amounts.

Such tinges, slight to marked, occur in about 4% of the largest (IV) and smallest (I) females, *stricklandi* (*sensu strictu*) and "*sitkensis*." In II, about 10% of the females show pinkish, whereas in III only 2.5% do so. These are the figures for some 705 females assembled in Oct. 1975 (at DEL); they may be slightly exaggerated for the smaller races, as the material borrowed was selected, to some extent, to show variations in color of small females.

#### VARIATIONS IN MALE COLORS

Griscom (1937) placed considerable emphasis on "xanthochroism," using it as a character to determine the origin of vagrant males, although he never fully explained just how much yellow constituted "xanthochroism." Tordoff (1952) suggested either abnormal diet or "hormonal imbalance" as the cause of greenish colors replacing red in late winter in Kansas (where there are no pine forests). I suspect that dietary (mineral?) deficiencies underlie most general "xanthochroism"; and as pointed out by Phillips, Marshall, and Monson (1964), Griscom's other color characters are mostly due to wear, molt, and the inevitable dirt that characterizes many crossbill specimens.

Not all adult males have red-edged primaries and rectrices. One with fresh, adult-shaped rectrices with greenish edgings is from Idaho (III; US 463578, 30 Nov.); its primary-edgings are not noticeably reddish either, whereas the new body plumage is mixed ochre and dull salmon-pinkish (the back is largely buffy olive), likewise devoid of bright red. Yet it is clearly adult, just finishing the primary molt (primaries 8 and 9 are not fullgrown); neither the first prebasic molt nor the limited first prealternate molt includes the primaries or their coverts (cf. Stone, 1896; Dwight, 1900). Another such male is US 396366 (Idaho, 24 Oct.), which still retains a few old outer rectrices and two outer pairs of old primaries; it is coming into a yellow, or mostly yellow, body plumage, and the primary-edgings show only a hint of reddish, and even this is confined to the two innermost pairs. A Swedish male *L. c. curvirostra* finishing the molt of its primaries, BM 1957. 8.55 (18 Nov.), is also dull; the body is dull, pale pink, the primary-edgings are olive-brown with a very slight yellowish tinge (this mainly on the palest, outer primaries), and the rectrix-edgings are a similar brown, graying to about fuscous terminally and with a very slight reddish tinge basally.

Four Colorado males (III, DEN 25677, -80, -81, -90) show, in most cases, grayish-edged primaries and rectrices, although most or all seem to be adults; being April birds, however, they show no wing molt.

On the other hand, an Arizona male (II; MICH 68254, 6 Nov.) seems immature on the basis of its inner primary-coverts and outermost greater secondary-coverts; its tertials also have narrow pale edgings, yet both primaries and tail are edged with pinkish.

Similarly, a red Pennsylvania ♂ (II; NMW) shows red-edged rectrices and tertials, yet its outermost greater and middle secondary-coverts are juvenal, as are also apparently the primary-coverts, and both the primaries and the inner secondaries are pale-edged. Hopefully such red-edged immatures are less usual than the olive edgings of apparent adults, further examples of which are a Michigan III (PMZ 13258) and an Arizona IV (AMR 3666).

Other complications that may hinder age determination are interrupted primary molts and inexplicably irregular ones. The central primaries may be more worn than either the outer ones or the innermost (nos. 1 and 2). Examples are 2 ♂ III (DEN 33830, -33). When molt is interrupted, the old outer primaries may be relatively short compared to the new inner and middle ones, even though wear does not seem great; presumably they are still of the juvenal generation. Care must be taken in claiming an interrupted molt, as appearances may be deceptive.

#### SUMMARY

In North America, immature Red Crossbills, although often retaining fully streaked juvenal feathers on the body (particularly the belly), are best distinguished from adults by the pale edgings or tips of various wing feathers. Not infrequently these form narrow pale wing-bars, and a few extremely white-marked young Red Crossbills resemble White-winged Crossbills except for the narrower, less purely white anterior wing-bar. Wing-bars are infrequent in the smallest races and in females, however. In adults the wing is practically solidly dark, and adult males commonly show reddish edgings to the alula feathers, primaries, and primary- and greater secondary-coverts.

In the larger races, females usually differ from males in their dull gray to whitish throats, often with dark speckling posteriorly; these contrast sharply to the chest. In the smallest females, however, the chest color often washes or even covers the throat posteriorly, but from the eye-region forward it is restricted to the median part of the throat. Males, after the first prebasic molt, have bright throats; dull gray is limited to the chin and, at times, a narrower submalar line.

Body—even crown—coloration is of limited use for sex and age determination. Females show traces of ocher, pink, or rust-red tones in about 2.5 to 10% of the specimens, according to the size-class involved, and occasionally are largely of these colors; most bright females are young. Conversely, adult males may be dull or yellow. Examples of variations in both sexes are cited.

Molts are sometimes irregular, or interrupted, and young birds may develop with extraordinary rapidity. But the idea that crossbills' skulls do not always pneumatize or ossify fully, as do other oscines, proves to be unfounded.

## LITERATURE CITED

- BROWN, N. C. 1883. Immaturity vs. individual variation. *Bull. Nuttall Ornithol. Club*, **8**: 46-48.
- DWIGHT, J., JR. 1900. The sequence of plumages and moults of the Passerine birds of New York. *Ann. N. Y. Acad. Sci.*, **13**: 73-360.
- GRISCOM, L. 1937. A monographic study of the Red Crossbill. *Proc. Boston Soc. Nat. Hist.*, **41**: 77-210.
- MAUERSBERGER, G. 1976. Zur Feldkennzeichnung der Kreuzschnablearten und zum Status von Sichtnachweisen. *Der Falke*, **23**(2): 51-55.
- MCCABE, T. T., AND E. B. MCCABE. 1933. Notes on the anatomy and breeding habits of crossbills. *Condor*, **35**: 136-147.
- PHILLIPS, A. R. 1975. Why neglect the difficult? *Western Birds*, **6**: 69-86.
- PHILLIPS, A., J. MARSHALL, AND G. MONSON. 1964. *The Birds of Arizona*. Tucson, Univ. Ariz. Press.
- RIDGWAY, R. 1912. *Color Standards and Color nomenclature*. Washington, D. C., privately published.
- SMITHE, F. B. 1975. *Naturalist's color guide*. Part 1. [N. York]: American Mus. Nat. Hist.
- STONE, W. 1896. The molting of birds, with special reference to the plumage of the smaller land birds of Eastern North America. *Proc. Acad. Nat. Sci. Philadelphia*, 1896: 108-167.
- TORDOFF, H. B. 1952. Notes on plumages, molts, and age variation of the Red Crossbill. *Condor*, **54**: 200-203.
- WITHERBY, H. F., F. C. R. JOURDAIN, N. F. TICEHURST, AND B. W. TUCKER. 1938. *The Handbook of British birds*. Vol. 1. London, H. F. & G. Witherby Ltd.

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