BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. XXV OCTOBER, 1954 No. 4

GAPE COLOR IN EASTERN PURPLE FINCHES

(Carpodacus p. purpurens)

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In some of our passerines the color of the gape, the soft skin at the angle of the mouth, is known to show rather striking changes with age and possibly with season. The attempt has been made to use the color of the gape as an indicator of sex in the Purple Finch. Magee (1927) and C. L. Whittle (1928) have both expressed opinions on the point. The former is quite definite in stating a sequence of colors: deep yellow, orange-yellow, orange, red-orange, and, in the most highly colored old males, orange-red as the colors passed through by the gape of adult males at the postnuptial molt. He says further that all brownish birds which show an orange or red-orange gape are males. Whittle, on the other hand, is not categorical in the matter of sex but holds that orange occurs only during the postnuptial molt while yellow is not "so directly connected with a condition of molt" (page 25).

I am greatly indebted to Mr. and Mrs. Parker C. Reed of Lexington, Mass., and Mr. John W. Stewart of Burlington, Mass., for access to their extensive notes on banded Purple Finches. These, with my own data, yield 1569 observations of gape color. Although the number of observations varies greatly from month to month, the over-all results are quite consistent.

The data have been grouped in six color categories, each of which, for averaging purposes, has been given a rank number as shown in the column headings of Table I. "Dull yellow, etc." (6) includes several pale, often grayish variants of yellow. These range from whitish to ochre and include a few instances of "flesh" whose pinkish tint seems due to blood rather than carotenoids. Undoubtedly there are inconsistencies in naming the gape color of individual birds and in my interpretation of the records.

The data have also been grouped in four type categories. Rosy males include all males whose color was indicated as being essentially that of fully colored adult males. Pink males are not fully colored but pale or merely ruddy or with restricted rosy coloration. Many of these birds are certainly young of the year and it is possible that a few are very old females. Juvenal is used for individuals whose plumage or molt characters safely assigned them as birds of the year. The majority of the population falls into the more indefinite category of "brown birds." It is unlikely that more than 20 or 30 percent of these, during July to November, are actually passing through postnuptial molt. Mostly they are unrecognized juvenals.

TABLE I

Percentages of each gape color for each month, numbers of observations, and average colors.

Month	Number of observations	Red (1)	Red orange (2)	Orange (3)	Orange yellow (4)	Yellow (5)	Dull yellow (6)	Average color	Number of observations	Red (1)	Red orange (2)	Orange (3)	Orange yellow (4)	Yellow (5)	Dull yellow (6)	Average color
	ADULT MALES								PINK MALES							
Jan.	38			3	11	53	34	5.2	7					+	+	5.3
Feb.	51				8	12	80	5.7	24					42	58	5.6
Mar.	60				3	70	27	5.2	12				8	58	33	5.2
Apr.	109				18	73	9	4.9	15			11		86		4.7
May	16				12	69	18	5.1	18				22	39	39	5.2
June	3						+	6.0	1					++		5.0
July	8		+	+		+	+	3.9	4		+			+	+	3.7
Aug.	4		+	++				2.5	5		++	+				2.6
Sept.	28		10	57	7	23	3	3.2	26		3	35	16	46		4.2
Oct.	20		5	60	25	5	5	3.4	15		13	13	7	47	20	4.5
Nov.	5			+	+	+	+	4.6	1				+			4.0
Dec.	19			5	21	37	37	5.0	9			11		67	22	5.0
Total	361								137							
	OTHER BROWN BIRDS								JUVENALS							
Jan.	50					64	36	5.4								
Feb.	59					27	73	5.7								
Mar.	94					83	17	5.2								
Apr.	281			4	10	81	5	4.9								
May	41				17	76	7	4.9								
June	10				40		60	5.2								
July	58	2	3	19	12	10	54	4.9	1						+	6.0
Aug.	111	2	11	16	7	14	50	4.7	15		7	27		7	60	4.9
Sept.	94		1	7	6	65	20	5.0	29		10	10	7	35	38	4.8
Oct.	72			3	1	84	12	4.9	7					+	+	5.3
Nov.	18					61	39	5.4								
Dec.	131			1	2	21	77	5.8								
Total	1019								52							

+indicates occurrence when the month's total is too small to yield useful percentages.

A further deficiency, which seems not to have much effect on the general picture, is the small amount of data available for certain months. This can be remedied in time and it did not seem worthwhile to wait longer before submitting the results to the criticism and improvement that I hope will come from other workers.

Even with these sources of error, for which allowance cannot yet be made, the pattern of seasonal variation in adult males is clear. From November through June no color further toward the red than orange-yellow has been recorded except one orange gaped bird each in November, December, and January. In the four months, July to October, both orange and red-orange have been noted. As a conservative conclusion from the table the majority of the birds will show a yellow or dull yellow gape from December to May and an orange one in September and October. Ultimately the majority color in the months December and January may prove to be light or dull yellow (as in February) and orange, or even red-orange, in August.

The group of pink males has a very similar color distribution to that of adult males. The major difference is that the average color is one grade yellower in September and October.

Taking known brown birds of the year (ignoring the one July observation) and other brown birds together, the range of average color for the whole year is only 1.1 grades. However, red and red-orange are found only from July to September. The difference from the first two categories seems to reside in the greater proportion of yellow and dull yellow gapes, rather than in a more restricted color range. The category "other brown birds" very probably contains 70 or 80 percent of birds less than one year old.

The three classes represented in the months January to May show no significant differences between the classes.

Apparently both Whittle and Magee were correct. The redder colors are associated, at least in fall, with the molt and, to a degree, with maleness. It may well prove that redness is related to age, least in juvenal birds and greatest in old males and females. The male series is not large enough to yield records of actual red gapes although they are known for a very small number of brown birds. There is a mere hint that gape color is a little redder in April than in May or June. If this be so, it may be associated with the very limited prenuptial molt which would occur mostly in April. (One record of molt is at hand for April 19.)

It is still not certain that orange and red-orange gapes seen in a few brown birds in postjuvenal molt indicate male birds. It is now clear that a large proportion of pink males are in first winter plumage. The group of pink males is only about a half grade redder than the brown birds of the year in September. The latter group must be roughly half female. This comparison suggests that maleness is not very significant in determining gape color at the postjuvenal molt. It may only be consequential in those male birds which acquire a pink or ruddy color at the postjuvenal molt, but quite sporadic in those that do not.

I will hazard a guess as to the association of redness of gape with molt. It is clear that in adult males at the postnuptial molt a considerable quantity of carotenoid pigment must be available just beneath the skin in chromatophores from some of which it will be transferred to the developing feathers. It is not unlikely that some of these chromatophores always develop some pigment. It also seems reasonable that an increase in pigmentation around the feather follicles may be accompanied by an increase over the rest of the pigmented surface of the body. The gape is the only such area which is not also rather heavily pigmented with melanin. Hence the gape is the only unfeathered area likely to show reddening in molt in adult males. We may carry our hypothesis a step further and suppose that more or less concentration of carotenoids occurs at molt in all Purple Finches but that in females and most male birds of the year the pigment simply fails to be transferred from the chromatophores to the feathers.

REFERENCES

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INTERRELATIONS BETWEEN CLUTCH-SIZE, BROOD-SIZE, PREFLEDGING SURVIVAL, AND WEIGHT IN KENT ISLAND TREE SWALLOWS (concluded)

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DISCUSSION

Throughout this paper a number of curious phenomena have been exposed; some are easily explained in the light of other observations in this study or by reference to other studies, some seem reasonable although their underlying causes are obscure, and some seem to be baffling contradictions or outright errors. An attempt will now be made to reconcile these data and to present a clearer picture of the complexities of the breeding biology of the tree swallow.

It has been shown that the mean clutch-size of the first nestings of the season is significantly higher than that of later nestings, but because we do not know the frequencies of repeat laying and of late first nestings within the sample, it is impossible to ascribe a cause for the reductions in clutch-size later in the season. It has been suggested that the late nestings in this study may actually represent layings after the desertion of earlier nests. The close uniformity in the time of the late nestings seems to indicate that the birds abandoned their nests after a storm earlier in the spring and all came into breeding condition again at approximately the same date. However, we know that at least one bird did not have a first clutch since one more nest was built late in the season than was abandoned. There may have been others. It is well known that when normally single-brooded birds lay second