

LIFE HISTORY OF THE BLACK ROSY FINCH

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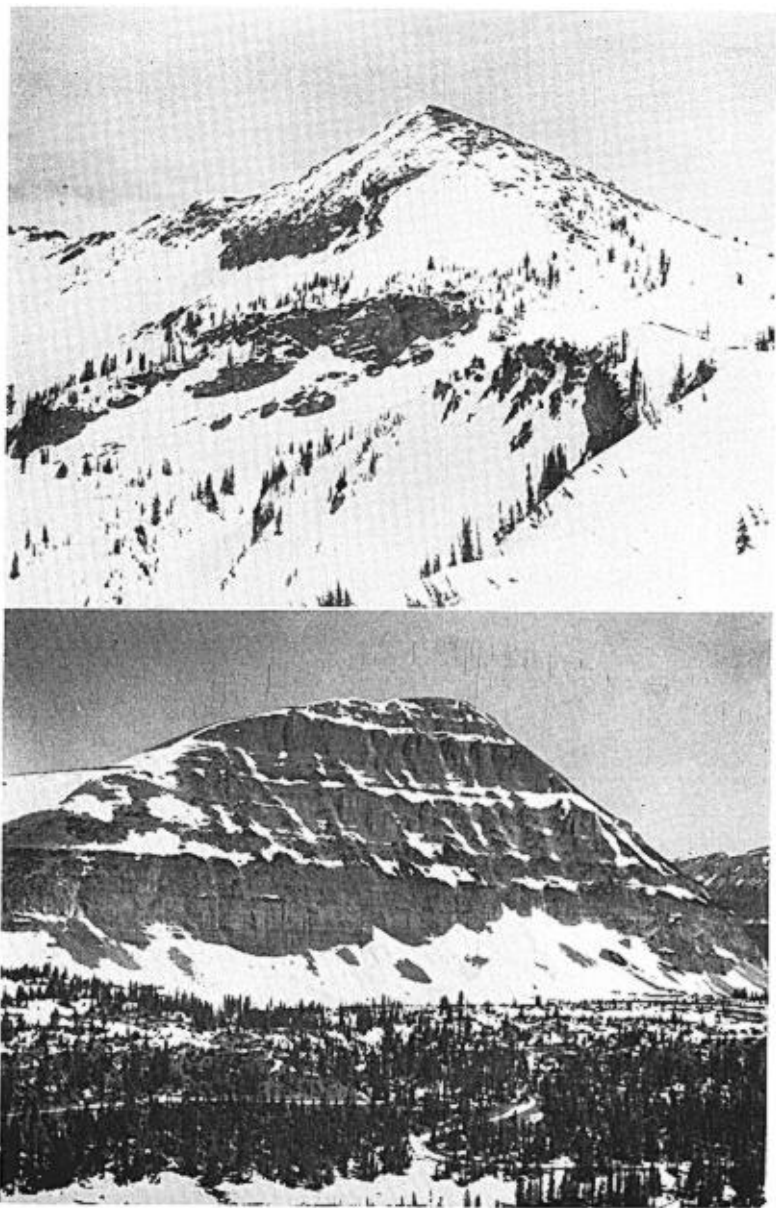
THE Black Rosy Finch, *Leucosticte tephrocotis atrata*, is a member of a genus of birds restricted in their breeding range to the high altitudes of the mountains of western North America and Asia. No previous intensive study has been made of this form. The North American rosy finches are usually considered three species (*L. tephrocotis* with several subspecies, *L. atrata*, and *L. australis*), because of their somewhat different coloration and their presumed allopatric distribution (A.O.U. Check-list, 1957: 564-566). The breeding range of the Black Rosy Finch, interposed between those of *L.t. tephrocotis* and *L.t. australis*, includes the mountains of Idaho, Montana, Utah, Wyoming and northeastern Nevada. During these studies, at least two regions of intergradation were found in the mountains of Idaho and Montana where populational interchange, with resulting mixing of characters of *L.t. tephrocotis* and *L.t. atrata*, occurs. Detailed distributional data have been presented in a separate paper (French, 1959), and the conclusion has been reached that all the American rosy finches should be treated as races of one species, *L. tephrocotis*.

The Black Rosy Finch is the only American *Leucosticte* showing strong sexual dimorphism. The male is sooty black, with a pink wash on the lateral parts of the body, especially intense on the wing and tail coverts, and with a light gray crescent extending from eye to eye over the back of the crown. The female is much duller, has the back and wings more brownish, the abdomen grayish, the head markings indistinct, and the pink wash paler, sometimes buffy or whitish.

During the breeding season the Black Rosy Finch is found only above timberline. This may be upwards of 9,000 feet in some mountain ranges, while in others birds breed only above 11,000 feet elevation. In the mountains inhabited there seems to be no upper altitudinal limit to the range. In winter Black Rosy Finches descend to lower elevations, being found in flocks from 7,000 feet down to at least 4,000 feet in valleys of southern Wyoming, western Colorado, Utah, Nevada, and adjacent parts of California, and New Mexico.

STUDY AREA AND METHODS

Three summers, 1951, 1952, and 1953, were spent making daily observations of Black Rosy Finches in their breeding habitat in the Teton and Absaroka mountains of Wyoming and the Uinta Mountains of Utah. In addition, at least eight other mountain ranges were visited to observe and collect specimens. Winter observations and



Breeding habitat of the Black Rosy Finch (*Leucosticte t. atrata*). (Above) Condition above 10,000 feet elevation in the Wasatch Mountains of Utah in April, 1953, at the time of arrival of the birds on the breeding grounds. (Below) Cliff utilized for nesting by the birds. Bald Mountain, Uinta Mountains, Utah, June, 1953.

banding were done mainly in the vicinity of Salt Lake City. A total of nearly three hundred rosy finches was banded, half of which were Black Rosy Finches.

BREEDING ACTIVITIES

From mid-February until the end of March on the wintering grounds near Salt Lake City in 1953, and again in 1954, increasing frequencies of fights between males occurred. These were short charges while feeding on the ground, or vigorous aerial chases. Although I once observed a male displaying before a female at a winter roost on March 15, 1953, it is doubtful that pairing takes place before the birds return to the breeding range. Rosy finches abandon their regular winter roosts near Salt Lake City before the end of March.

In 1953 Black Rosy Finches were observed on the breeding grounds at 11,000 feet elevation in the Wasatch Mountains of Utah on April 5. Bleak winter conditions still prevailed (Plate 5). Because of the wind, a male attempting to display before a female held his position in front of her with great difficulty.

Once on the breeding grounds the males attempt to attract prospective mates by displaying, chirping and following the females about. Only one male has been observed displaying to a female at any given time. A considerable amount of time is still spent by the birds feeding quietly in flocks. The female remains in proestrus until some time after the first of June. As the breeding season advances the males become more persistent in their efforts. With the approach of oestrus the females begin to take notice of the activities of the males. The female bird shows interest in the display of the male by either approaching him, watching all his movements carefully, or failing to retreat when he approaches. This activity, observed on several occasions, results in copulation, after which the pair begins search for a nest site.

Display.—The display of the male was observed only when a female was present. I have observed birds displaying on the ground and on the side of a cliff. The male lowers the forepart of the body and tips the head far back, holding its bill high. The tail is held up nearly perpendicular to the back. The wings are slightly extended and vibrated rapidly. The bird utters a high continuous chirping sound. Grass is often held in the bill during this time. When the female is receptive she assumes a similar position. The posterior portion of the body is elevated, resulting in a sharp angle between the back of the bird and the top of the head. She chirps like the male and may or may not flutter the wings. When she is in this position

the male mounts her, and coition takes place by brief cloacal contact. When not actually displaying the male spends much of his time, while in the vicinity of the female, with the body feathers fluffed out. This makes him appear twice his normal size and, with his head lowered and bill opened, serves as a threat posture directed toward other birds that approach too closely.

Territory.—The “territory” of the Black Rosy Finch fits none of the categories into which birds territories have been classified. (Nice, 1943: 163). In this form, as in the Sierra Nevada Gray-crowned Rosy Finch, *L.t. dawsoni*, described by Twining (1938: 246), the “territory” centers around the female bird. It varies in location and size with the movements of the female and with the activities of unmated males in the vicinity.

On June 22, 1953, in the Uinta Mountains a female Black Rosy Finch was investigating various parts of a thirty foot vertical crack on a high cliff and a male was busy trying to drive off other males. The defending male had a chase or a fight on the average of once every two minutes. These were vigorous chases, sometimes involving more than two birds. When not so occupied, the male remained close to the female, but this was seldom.

Similar observations were made almost daily until as late as July 4. During this period, a nest site was chosen and the nest built and probably completed. At some times not a single bird could be seen in the area. On one occasion when there was no activity a male appeared, flew to three different places in the large crack, which had been the center of the female's attention, and then flew away from the area after finding no other birds there. Later, when the female appeared, there were three males continually fighting. The female, being less active and sometimes hard to locate, could usually be found by noting the vicinity where most of the fighting took place. As the female moved about, so did the fighting males. When the female left the area and disappeared over the top of the cliff or around the side of the mountain, the males immediately followed. Such fighting has also been observed among feeding birds. During June and most of July a feeding female is always accompanied by a male. If another male approaches, a fight ensues. The most vigorous reaction is brought on by the combination of female and nest site. A lesser response occurs with the female away from the nest site. In the former case a strange male will not be tolerated within perhaps thirty or forty yards of the female. In the latter case a strange male may not be driven off until it is closer to the female than her mate.

The fighting centers around the female, whether this bird is in

the vicinity of the nest or on the feeding grounds. Even a nest containing eggs is left unguarded by the male if the female leaves it. From such observations I conclude that it is the female rather than an area that is defended.

This is a special type of territory made necessary perhaps by the unbalanced sex ratio in the species and by the circumstances under which it lives. The nest site may be widely separated from the feeding area. A single bird cannot defend both. While suitable nest sites and foraging areas appear to be abundant, females are comparatively scarce. It is biologically sound then that the weakest or most critical point needed for completion of the breeding cycle be defended. In this case it is the female.

Nest site.—Selection of the nest site is by the female. Of the eight active nests observed during the course of this study seven were in holes or cracks on vertical cliffs (Plate 5), protected from above and from all sides except the entrance. The edge of the nest was no more than five inches back from the entrance in the seven nests. In the Uinta Mountains one nest was placed in the rocks of an extensive talus slope. Except for its location on the ground, the nest was as well protected as any of the others. It was placed under a large flat rock about five feet from the only possible entrance.

In general, it may be stated that the height at which a nest of the Black Rosy Finch is placed varies from ten feet upward. The only upward limitation seems to be the height of the available cliffs. The nest is invariably well protected and concealed because it is placed in a cavity. Although the birds can utilize talus for nest sites, the cliffs are preferred, probably because of the additional protection.

Nest building.—The earliest date on which I observed nest construction was June 11, 1953, in the Uinta Mountains. Since I could not begin regular observations in the breeding range before this date I cannot say whether other birds had already completed nest building. The latest nest construction I observed was on July 14, 1951, at Two Ocean Mountain in the southern Absarokas in Wyoming, (except for the building of a replacement nest after destruction of the first). My observations indicate the work is done entirely by the female. The male may attempt to gather material, but after carrying it from one place to another it is eventually dropped.

The nest.—Nest construction, once begun, is completed rapidly. In three nests observed under construction, trips to the site with material were made from once every ten seconds to once every two minutes. I noted this pace uninterrupted, hour after hour, at a nest in the Uinta Mountains on June 28, 1953. On the preceding

day I observed the female picking up grass, but carrying it slowly to the nest, making three or four stops on the way. On the 28th nest building proceeded rapidly and was probably very nearly completed. By the third day the bird was seen leisurely feeding in the vicinity of the nest, perhaps adding some material and spending considerable time on the final arrangement of it in the structure. This same pattern was evident at two earlier nests near the same location.

A typical nest found on July 27, 1951, at Two Ocean Mountain was cupped with high rims and completely supported from below, except where the sides rested against three sides of the nest cavity. The base was of mosses while the upper portion was of grass and hair, with some moss and feathers mixed in. The lining was of finer material, hair being the favorite item. Porcupine quills, thoroughly crushed and fragmented, were used along with hair in the main body of the nest. Mosses may have been present in the cavity, and the nest constructed on top of them. Another nest examined in the Teton Mountains in 1952 and two in the Uinta Mountains in 1953 were similar.

Eggs.—A nest in the Uinta Mountains was being rapidly constructed by the female on June 16, 1953. On June 18 neither the male nor the female was seen near the nest. On June 20 a male was seen a few hundred yards from the nest. On June 22 this nest contained two eggs and on June 26, five eggs.

The eggs of the Black Rosy Finch are pure white. As described by Miller (1925: 6), they are ovate pyriform in shape. They appear rather long and unusually pointed at one end. I found five nests with eggs or young. These were: the above mentioned set of five eggs; a nest with four well-developed young and one egg that had failed to hatch, found in the Uinta Mountains July 20, 1953; a set of four eggs in the Teton Mountains July 16, 1952; a complete set of three eggs, believed to be a replacement, found in the Teton Mountains July 21, 1952; and a nest with four young in the Absaroka Range July 29, 1951. The three sets collected by Miller (*loc. cit.*) contained five, four and four eggs. From these data it seems that the average number of eggs per set is four or five, with perhaps the smaller number occurring more frequently.

Replacement nest.—Early on the morning of July 16, 1952, in the Teton Mountains I saw a nest and four eggs of the Black Rosy Finch destroyed by a Clark's Nutcracker, *Nucifraga columbiana*, (see French, 1955: 61). A short time later both birds appeared to be examining the face of the cliff. The male once visited the former nest site and, just before dark, began his accustomed loud

territorial chirping from the top of the cliff. Five days after the destruction of the nest another was found in a new location on the same cliff about a hundred yards away. It contained three eggs, which proved to be the complete set. The entire face of this cliff had been defended, when the female was present, by the male to whom the destroyed nest had belonged, so I believe that this nest was constructed by the same pair. If the original female constructed this nest and laid the three eggs, she wasted no time after the destruction of her first nest. If one egg was laid per day, the new nest must have been completed the day after the destruction of the old nest. It is possible, however, that the nest may have been finished after laying of the first egg. The small size of the set seems to be further evidence that this was a case of replacement.

Incubation.—Incubation is entirely by the female and begins immediately after egg laying is completed. In the one nest studied intensively during this period, in the Uinta Mountains in late June and early July of 1953, the female incubated through the night and left the nest for the first feeding period of the day a little before 5:00 A.M., approximately one half hour after daybreak. The last foraging trip from the nest was made before 8:00 P.M., about one-half hour before total darkness. In mid-summer, the birds have about fifteen hours of activity daily.

The duration of incubation was determined in one nest as approximately twelve days and in another as approximately fourteen days. At the nest in the Uinta Mountains in 1953, there were two eggs on June 22 and five eggs on June 26. The female was incubating on the latter date. Three of the eggs hatched between noon of July 6 and 4:00 P.M. of July 7. One egg remained at 10:00 A.M. July 8, and twenty-four hours later the nest contained five young. On July 21, 1952, in the Teton Mountains a nest containing three eggs was discovered. This was the replacement nest discussed. These eggs hatched between the morning of July 31 and the morning of August 3.

Activity of male during incubation.—The male pays little or no attention to the female while she is on the nest. In only one instance did I see the male visit the nest while the female was incubating. At two other nests the male seemed to vacate the area completely during the period of incubation. At no time did I see him about the cliff, except usually in the evening just after sundown when he came to roost. Then the male chirped loudly and continuously from some high point on the cliff and drove away any other birds that approached. On July 9 in the dim light at 8:45 P.M. he even chased a bat that came too close!

Female birds observed on the feeding grounds during the period of incubation were accompanied by males, which usually drove away other males. It seems probable that the male either awaits the female on the feeding grounds or intercepts her after leaving the nest. The male then defends his mate while she feeds and remains behind when she returns to the nest. On several occasions I saw small groups of male Black Rosy Finches foraging about the face of the cliff, unchallenged, in the vicinity of the nest while the female was incubating. Apparently the male of the pair was not nearby. In the evening when the male came to roost such birds were driven away.

Nestlings and their care.—The young Black Rosy Finch at hatching is completely helpless and has only a sparse covering of long whitish natal down on the dorsal surface. Its reactions seem restricted to those concerned with nutrition, notably gaping by holding the head up with mouth open, and to defecation. At one nest in the Uinta Mountains, in July of 1953, the progress of the young was followed. The nest life lasted eighteen to twenty days. The last egg hatched on July 8 or 9 and the young left on July 27 or 28.

A young bird examined on the first day after hatching had a large head with eyes not yet open although the dark eyeballs were visible through the skin. The mouth was large due to the expanded rictal region. When open it showed a red lining contrasting with the yellow edge of the bill. By the fourth day the eyes of the young bird were opening and it showed better development of responses. It held its head up slightly, was more alert and struggled to remain upright. All the feather tracts appeared dark due to enlarged papillae. The primaries and rectrices had broken through the skin. Chirping was noted at this time. On the fifth day the eyes were well opened. All feathers had erupted. Coordination was improving rapidly on the fifth and sixth days. On the seventh day the tips of the contour feathers were beginning to break from their sheaths. Fat had begun to accumulate noticeably under all of the feather tracts and especially on the flanks and abdomen. A squeal of fear was given by the young bird for the first time while it was being removed from the nest. On the ninth and tenth days the developing sheaths were breaking away from the developing teleoptiles, allowing the barbs to spread and cover the apteria. By the eleventh day they began showing fear when handled. Wing-flapping, scratching, stretching and preening were observed in captive birds on the eleventh day. At this time one of the young attempted the adult manner of sleeping, with the head turned back over one shoulder and the bill under the scapulars.

On subsequent days the nest was checked only for the presence of the young and for such observations that could be made without disturbing them. By the twelfth day even the feathers of the crown were unsheathed. The light colored tufts of feathers that were to cover the nostrils were evident but sheathed. In captive young by the twelfth day the nestlings had established definite positions in the artificial nest provided for them. They always returned to the same place after being fed. Fecal sacs were defecated over the side of the nest.

The female performs all the brooding after the young have hatched. She also feeds them for the first few days. At first there is little change in the duration of periods spent by the female on the nest, but there is a continued increase in the feeding periods away from the nest. In three nests observed with small young, in the Absaroka Range in 1951, the Tetons in 1952, and the Uinta Mountains in 1953, there was a decrease in the length of periods of brooding by the female as the young birds grew. This allowed more frequent trips to the feeding grounds. After the sixth day no brooding was observed. The female remained at the nest only long enough to feed the young. Brooding at night may continue until about the sixth day.

Not until the sixth day did the male take part in feeding the young. His approach to the nest was at first slow and cautious, but by the seventh or eighth day the male fed the young as frequently as did the female. Both adults continued to care for the young until they were independent. The parent bird delivered the food by throwing its head forward in short quick thrusts. The young bird met the bill of the parent by throwing its head forward at the same time, receiving the bill of the parent in its own open mouth. Apparently, with each thrust some food was delivered. Nest sanitation was performed by both adults. The fecal sacs were dropped some distance from the nest, usually no less than several hundred feet.

Development of young after leaving the nest.—After the young leave the nest and before they can fly well they are especially susceptible to predation. The gray and buffy juvenal plumage matches very closely the rocks among which the young are situated so that concealment is accomplished merely by immobility. They are just as dependent upon the adults for food as before leaving the nest. Exploratory pecking increases dexterity of the bill and eventually leads to feeding themselves. (My captive young began to eat seed ten days after they left the nest.) Judging from the state of development of young birds collected that were being fed by adults, feeding by the parents probably continues as long as two weeks after the young are out of the nest.

The tendency of the young bird to follow the parent begging for food enables the parent to guide the young to a safe or suitable location. If the parent moves away slowly the young bird follows. If it suddenly flies away the young bird is left behind.

Aggregations of young.—Shortly after the young are out of the nest and are able to fly well, there seems to be a tendency for them to become concentrated in groups composed of few to many families. On August 4, 1952, in the Teton Mountains a group of adults and

young of at least three families, numbering in excess of fifteen individuals, was seen feeding. Soon the entire group moved to another location. On August 4, 1953, in the Wind River Range an extremely large group of young birds, perhaps fifty in number, was concentrated in a rocky area of perhaps a hundred yards in extent. Many families were included here and the adults were continually coming and going with food. A week earlier similar family flocks were observed on rocky slopes in the Uinta Mountains. In the latter part of August, large flocks of fifty or more birds, all or nearly all in juvenal plumage, were seen in the Wind River and Bitterroot Mountains.

A possible cause of these aggregations of families and of young birds is that the adults lead their offspring to the localities that afford them the most protection. In such places the birds would become concentrated. This, however, seems not to be the case, for the groups may occur in a variety of exposed situations, such as a rocky slope or an open grassy area. Moreover, such aggregations were seen to move from one location to another *en masse*. These aggregations seem to result from the gregarious tendencies which are so strongly developed throughout the genus *Leucosticte* during most of the year. Only at the approach of breeding do other drives result in temporarily breaking up of the groups.

With the groups thus formed parental care wanes. The young birds benefit from the added protection of the group, in warning of enemies and seeking out sources of food. By the time of the molt, in late August, the adults seem to be absent from the flocks. It seems possible that they may not actually leave the flocks but rather are less active and therefore make less effort to remain with them. Because the postjuvenal molt does not include the large flight feathers, as does the adult postnuptial molt, the young birds may not be so inhibited. Adults appear to rejoin the groups after this molting period, at which time all the birds are in fresh plumage. Separate groups may then coalesce into the large active flocks that may be seen in the high mountains until the fall migration.

VOICE AND SONG

There are only three primary notes used by the Black Rosy Finch. These, plus variations and combinations, serve all purposes. The three call notes are: a descending, rather harsh, *chew* or *tsew*, somewhat similar to the chirping of a House Sparrow (*Passer domesticus*); a low, throaty, sharp *pert*; a high piercing *peent*.

The descending *chew* is the most variable and has the greatest

number of uses. It is the one which most nearly resembles the begging note of the young. The other notes are apparently specializations which developed as the need arose. They can be traced, through variation, to the *chew* note. The roosting or territorial call consists of a series of *chew* notes uttered rapidly and continuously. The series ascends and descends the scale apparently at random. This call was heard nightly on the breeding grounds when the birds went to the cliffs to roost and seems to function in spacing the birds.

The high *peent* serves primarily as an alarm note. It is generally given when a bird is startled. If the bird or birds are on the ground it results in either flying or crouching. It is doubtful that flocks of rosy finches post sentinels as suggested by Twining (1940: 69). Some individuals, however, are more alert than others and probably do more than their share of watching.

Large flocks, and occasionally flying individuals, utter a call in flight which resembles *pert-pert-chew*, the first two notes low and brief, the last starting high and descending. This may be designated as the flock call and probably serves to hold the group together. It is heard most frequently in winter flocks, but is also given on the breeding grounds.

Although song has been attributed to the Rosy Finches of the Aleutians (*L. t. griseonucha*) and Washington (*L. t. littoralis*) (Hanna, 1922: 88; the Leffingwells, 1931: 144), it has never been satisfactorily described. The Leffingwells (*loc. cit.*) state that the birds were "trying" to sing. This may correspond to Dawson's (1923: 156) description of the song of the Sierra Nevada Rosy Finch (*L. t. dawsoni*) as a "high-pitched ecstatic chirping" (*chew* series). According to my observations on the Black Rosy Finch, that seems the best indication of the true sound given by these birds. Applying the definition of song favored by Nice (1943: 144), "song is properly a sustained, more or less uninterrupted repetition of one or more notes conforming recognizably to a constant specific type," the vocalizations of the Black Rosy Finch cannot be considered song.

The hand-raised young had two notes when they were first taken from the nest. One of these was a soft rasping chirp, which seemed to me a hunger note. When food appeared it gave way to the begging note, a loud piercing cry rapidly repeated. The young birds first gave the adult note on the twenty-sixth day. This was a low descending *chew*. It was first uttered when the bird was peering at something outside the cage. It was given again when two people suddenly came near the cage.

FOOD

The contents of the crops and gular sacs of seventy summer (June–August) adult specimens collected in 1951, 1952 and 1953 from mountains in western Wyoming, Montana and northern Utah were collected and preserved for later determination. The food consisted of 97% seed and 3% animal matter.

A reference collection of known seeds of the plants occurring in the areas frequented by the rosy finches was made to aid in the identifications. These data are presented in Table 1. Seeds are

TABLE 1
FOOD OF THE BLACK ROSY FINCH

<i>Food</i>	<i>Total Number</i>	<i>Number of Specimens Containing</i>	<i>% of Total seeds</i>	<i>% of Total food</i>	<i>% of specimens containing</i>
<i>Seeds</i>					
<i>Siviersia</i>	1212	20	14.6%	14.2%	48.8%
<i>Arabis</i>	1495	11	18.0	17.5	26.8
<i>Smelowskia</i>	2245	17	27.1	26.3	41.5
<i>Silene</i>	1911	22	23.1	22.4	53.7
<i>Lewisia</i>	527	8	6.4	6.2	19.5
<i>Claytonia</i>	103	3	1.2	1.2	7.3
<i>Carex</i>	22	3	0.3	0.3	7.3
<i>Sibbaldia</i>	213	11	2.6	2.5	26.8
<i>Myosotis</i>	22	4	0.3	0.3	9.8
<i>Erigeron</i> & <i>Aster</i>	351	2	4.2	4.1	4.9
<i>Oxyria</i>	3	2	<0.1	<0.1	4.9
grass	181	2	2.2	2.1	4.9
<i>Animals</i>					
			<i>% of total animals</i>		
<i>Lepidoptera</i>	23	15	9.1	0.3	36.6
<i>Coleoptera</i>	17	6	6.8	0.2	14.6
<i>Diptera</i>	13	10	5.2	0.2	24.4
<i>Hymenoptera</i>	22	16	8.7	0.3	39.0
<i>Homoptera</i>	61	4	24.2	0.7	9.8
<i>Ephemeroptera</i>	12	1	4.8	0.1	2.4
pupae	13	2	5.2	0.2	4.9
unidentified	21	6	8.3	0.2	14.6
<i>Araneida</i>	11	3	4.4	0.1	7.3
<i>Acarina</i>	46	11	18.2	0.5	26.8
<i>Nematoda</i>	13	2	5.2	0.2	4.9
Total % unidentified 33.6%					
Total no. specimens represented 70					
				% total food	
				seed	97.2%
				animal	2.8%

listed by genera, except for grasses, and animal matter is listed by order for the insects and by classes for others. Quantity is indicated by the actual number of items in the particular sample and by percent of total numbers. The percent by volume of unidentified material is estimated. Some confusion in identification may have occurred as between seeds of *Arabis* and *Smelowskia* or as between seeds of *Sibbaldia* and *Siversia*. Seeds of *Smelowskia* and *Silene* were most numerous; those of *Silene* and *Siversia* were utilized by the greatest number of individuals. Animals which were most numerous included Homoptera and Acarina, while those used by the greatest number of birds were Homoptera and Lepidoptera.

There is a sharp decline in the amount of animal matter in the diet of the rosy finches after the middle of August. This is presumably due to the change of diet of the young as they become independent.

The growing season in the breeding habitat is short. Some of the food plants used by the Black Rosy Finch, such as *Siversia* and *Erigeron*, do not appear until after the month of August. Others, such as *Smelowskia* and *Silene*, put in their appearance soon after the snow has melted. In the Uinta Mountains in the summer of 1953, the ground was completely covered by snow until the middle of June. Only after this date did bare patches become visible in the more exposed areas. By this time the nesting activities of the rosy finches were well under way.

As the birds are present on the breeding grounds from early April, they must rely upon the seeds produced during the previous season. Seeds are probably abundant wherever there is bare ground that has been swept clear of snow by the wind. Open ground is not scarce. The high ridges and peaks above timberline are constantly lashed by strong winds, especially during the winter and early spring. Judging from the observed activity of Black Rosy Finches, they have little difficulty finding food in such situations.

In the summer of 1951 at Two Ocean Mountain, situated at the southern edge of the Absaroka Range, no insects were noticed until July 13. Within three days after their first appearance they were extremely abundant, particularly mosquitoes. In rosy finch habitat in the Teton Mountains on June 30, 1952, a hawkmoth and a stonefly were noticed on the snow, the former lifeless and the latter numbed by the cold. There were also some small dipterans. On April 26, 1953, insects were observed in the Wasatch Mountains on a high peak frequented by Black Rosy Finches. On June 10 in the Uinta Mountains insects were present.

Hence, in some localities, there is no apparent shortage of insect

food. Early in the season insects are probably carried up from lower elevations by the wind, being left on the snow as a temporary supply. In the Absaroka Range insects suddenly became abundant. Near the area studied are only high mountain valleys where there would be no source of insects. The change in abundance of insects there appeared to be correlated with an equally abrupt climatic change, after which the high mountains suddenly became habitable to various insects and they rapidly increased in numbers. This phenomenon may apply only to the locality where it was observed.

Food of nestlings.—After hatching, young Black Rosy Finches are given a diet consisting largely of insects. During the early nestling stage of one brood in the Absaroka Range in 1951, the adult female was observed chasing insects about the face of the cliff on which the nest was situated. This activity was interrupted only by trips to the nest to feed the young. During the time of observation the brood was receiving only insect food. By the time the nestlings were nine days old, they received some seeds along with the insect diet. After this time seeds are more and more abundant in the food. By the time the young birds leave the nest they are being fed mostly seeds, with only a few insects.

Effect of food on breeding activities.—If the newly hatched Black Rosy Finch requires a diet of insects, a brood of four or five young birds would necessitate an abundant source of this food. Since insect activity is limited by cold at high elevations, this factor in turn must limit the advent of the breeding season for the birds. The three days of July 14, 15 and 16 in 1951 which seemed to bring milder temperatures to Two Ocean Mountain in the Absaroka Range and a sudden increase in insects also brought a corresponding change in the activities of the Black Rosy Finches. During this period of observation prior to the change the birds were frequently observed feeding together in small flocks on the tundra. At the same time the insects became noticeable the birds showed increased signs of breeding activity. Displays of male birds were more frequent, with or without a female being present, and antagonism between male birds increased, as evidenced by more frequent and more intense fighting. In one case on July 15 a female was observed investigating cracks and holes in a large cliff, showing interest in possible nest sites. She was accompanied by a male. After a time it became apparent that the complacent flocks of feeding birds were replaced by singles or pairs. In this particular example it seemed that the increasing insect supply was correlated with the beginning of breeding. Because the growing season is extremely short at high altitudes, even a slight delay in nesting might impose a serious handicap on the young birds.

Foraging places.—Seeds are usually gathered on the tundra or in open areas. The Black Rosy Finches show definite preference for foraging on and about snow banks. The birds frequently drink water from the melting snow and the proximity of this water may be one reason for foraging there. The seeds and the ground itself are moist and may simplify collection and manipulation of food. Germinating material forms a considerable amount of the food and the moist areas provide the best supply. A receding snow bank is continually uncovering a fresh supply of food, and numbed insects can be gleaned from its surface.

The birds also have been seen, on rare occasions, taking seeds directly from the heads of flowers. Insects may be flushed from the ground and caught on the wing. Whole flocks of the birds may take advantage of an accumulation of moths on a warm rocky slope above timberline. I have also observed birds on the margins of ponds feeding on mayflies, usually collecting them from the rocks.

FLOCKING BEHAVIOR

The flocks of rosy finches are not closed flocks where strange birds are not admitted. Rather they are somewhat flexible, a few individuals departing as a group from the main flock or small groups coalescing to form a single large flock. This seems to vary with the familiarity of the surroundings. In the afternoon when the birds are in the vicinity of the roost the flocks may be quite loose, individuals coming and going at random. Early in the day, however, when the birds are away from the roost foraging in presumably less familiar regions, the birds remain in a close group and when one bird flies the entire group takes off.

In rosy finches the "following reaction" (Nice, 1943: 86) is highly developed, as it is in many social species. In flying flocks there seems to be no particular leader. The group moves as a whole and a bird that was apparently leading the flock will find itself on the sidelines when the flock changes its direction of movement. As in the Jackdaws (*Corvus monedula*) described by Lorenz (1937), the individual which acts as though it knows where it is going is temporarily the leader. The following reaction seems to be most highly developed in the response of the flock to a bird that flies. When one bird among the group suddenly flies the flock literally explodes in an effort to follow. The reaction is an automatic one. In the words of Lorenz (*op. cit.*: 252), "The only example of such automatic releasers known to me, is represented by the devices eliciting flying-in-pursuit reactions in a great many social birds. All of them are color patterns invisible in

the sitting bird, but are suddenly and strikingly unfolded at the moment of taking flight." In the leucostictes the releaser is apparently the light gray color of the under surface of the wing. The structure of the primary and secondary feathers gives this surface a dull luster when the wing is spread. The flashing movements of the beating wings cause this surface rapidly to appear and disappear, producing a strikingly visible effect. The luster of the under surface of the wing is so apparent that this is frequently the only means of following a bird that is flying high in the air. In the pause between a series of rapid wing beats the flying bird is invisible to the human eye, but the beating wings can be plainly seen flashing, appearing white against the blue sky. Flashing wings seemed to be one thing that the captive birds could not resist following. A bird might appear completely absorbed in some small object but when the other bird flew close overhead the first bird immediately forgot what had formerly interested it and followed. This was especially true if the second bird had just taken off and the wings above were noisily straining in the effort to gain elevation.

There are certain other signals that serve to bring and to hold the group together. The auditory signals have already been discussed. The means by which a flying bird recognizes an almost imperceptible flock feeding on the ground is uncertain. Numerous times I have observed a lone bird, flying quite high, turn abruptly when almost directly over the flock and plummet straight down to alight among them. The turning point seems to come when the bird is directly over the feeding birds. Whether this is a peculiar habit of flight or some signal is received at that particular point is uncertain. It seems possible that the striking gray crown patch may serve some function here.

WINTER ROOSTS

The rosy finches have communal roosts in winter. The same roost is utilized by the birds year after year. I would estimate the numbers of birds utilizing each of the four roosting locations I have observed between 200 and 600. The known winter roosts are few but in at least two locations the same shelter has been used by the rosy finches for several years. The primary requirement seems to be overhead shelter. Since the birds are gregarious there must be an abundance of perching space. In addition, the birds usually choose perches against walls or in corners where there is also protection from the sides.

Two roosts located near Salt Lake City are both man-made structures. A recreation establishment on the shore of Great Salt Lake ("Saltair") provided an abundance of roosting sites such as the sup-

porting structure of an elevated pier, change rooms used in summer by swimmers, elevated water tanks, and open-sided railroad cars (Plate 6). A few miles south is an explosives manufacturing plant where rosy finches roosted. Numerous buildings rather widely spaced provided suitable roosts on beams, door sills, under eaves, etc. *L.t. tephrocotis*, *L.t. littoralis*, and *L.t. atrata* were reported wintering at this roost (Behle, 1944) and were still utilizing it ten years later.

During the winter of 1953-54, the most intensive banding was done at the two roosts. Forty-nine birds were recaptured at the same roost where they were banded, 30 *atrata*, 16 *littoralis* and 3 *tephrocotis*. Only twice were birds, both male *atrata*, recaptured at a roost other than that at which they were banded, one during the same winter, the other a year and a half later. One bird, also a male *atrata*, was found at the same roost thirteen months after it was banded there. The oldest bird observed was a male *atrata* banded in March of 1953 and recovered at the same roost in January, 1957.

Rosy finches were reported roosting in mine shafts in eastern California by Miller and Twining (1943: 78). There have been reports of the birds roosting in abandoned Cliff Swallow nests (Leffingwell and Leffingwell, 1931). This may seem an unusual situation but it apparently meets all requirements. In Colorado I observed all four varieties of rosy finches roosting in a cave formed by a crack, two feet wide at the top and nearly ten feet wide at the bottom, which extended through a large rock nearly a hundred feet in height and equally broad. The birds entered through the widest opening in the cave and were probably roosting on projections or cavities in the walls. *L.t. tephrocotis* and *L.t. littoralis* were also found utilizing the entrance of a large cave in southeastern Idaho (Plate 6).

In the winter of 1952-53 the rosy finches roosting in the railroad cars at Saltair were regularly and rather frequently disturbed at night for banding purposes. It was not long before the birds learned to avoid this disturbance by roosting elsewhere, under nearby water tanks and buildings. The same perches are repeatedly used by the birds throughout the winter and in some cases through successive seasons. Piles of excreta build up at certain spots due to continuous use while other perches, which appear equally suitable, go unused.

That the birds have taken advantage of man-made structures for roosting indicates that they are, in this respect, adaptable. Reports of their using abandoned buildings are not rare. Large flocks frequently visit human habitations in winter for food as well as shelter. There is one report (Cahn, 1947) of the Aleutian Rosy Finch, *L.t. griseonucha*, nesting on the window ledge of a warehouse. It is



Winter roosts of Rosy Finches. (Above) Pier at Great Salt Lake under which birds found shelter suitable for roosting. (Below) Entrance to cave in southeastern Idaho showing natural roost of the birds. Three to five hundred *Leucosticte t. tephrocotis* and *L.t. littoralis* have been seen coming to this roost an hour and a half before sundown. They utilize any spot in or around the cave entrance where there is an overhang to provide shelter, some birds roosting less than five feet above the ground.

entirely possible that rosy finches would become adapted to nesting in and about man's dwellings if such structures were erected in the breeding habitat of the birds.

THE FACTOR APPARENTLY LIMITING POPULATION

The density of the population in summer and winter must be considered separately. In the breeding season the individuals are so widely spaced that there seemingly could be many more in the available habitat. In localities where they have been observed there is abundant space for nest sites; there seems to be a great quantity of unutilized food and little or no competition for it.

In winter the birds occur in groups that are localized. These groups do not normally travel widely and there seems to be room and food available for many more groups than there are. Only for brief periods after heavy snowfall is food difficult to find. The areas inhabited by the birds in winter are for the most part free of excessive snow.

Although predators, such as the weasel and the Clark's Nutcracker, take a toll, this seems to have little effect on the population density. One brood of nestlings in northwestern Wyoming was infested with larval protocalliphorid flies. These were submitted to the National Museum for identification where they were considered a new species, but remain unnamed. There is no evidence that populations vary with the varying density of predators.

The only element in the life of the Black Rosy Finch that seems to be in shortage is the female of the species. All available evidence indicates that there is an unbalanced sex ratio. In winter flocks the birds were counted and it was found that there were always more males than females. The ratio varied from one female and six males to one female and fourteen males. Of the 93 Black Rosy Finches banded in the winter of 1953-54 fourteen were females and seventy-nine were males. This is a ratio of one female to 5.6 males. On the breeding grounds the same holds true. Male birds are not difficult to find but females are scarce. An estimate based on observations is one female to about six or eight males. The scarcity of female birds is also indicated by the situation described in the discussion of territory, where several males persist in their interest in a single female. This unbalanced ratio seems to exist in young birds also. Of seven birds taken in juvenal plumage only two were females. Of nine freshly molted birds collected, only two of the seven young birds were females, and a special effort was made to secure these. Of 118 specimens collected, I succeeded in taking only 38 females as compared

to 80 males. Again, extra effort was applied to securing females. A similar discrepancy in sex ratio has also been observed or indicated in *L.t. dawsoni* (Dawson, 1923, and Twining, 1938), and in *L.t. griseonucha* (Hanna, 1922).

IMMATURE PLUMAGES, MOLTS, PINK COLOR, AND BILL COLOR

Natal down.—The down feathers are approximately three-eighths of an inch in length, covering much of the dorsal surface of the bird, but arising from only a few limited areas: the capital tract on the top of the head, the dorsal region of the spinal tract in the middle of the back, the dorsal surface of the alar tract on the wing, the distal portion of the crural tract and the middle portion of the femoral tract just posterior to the thigh. On the top of the head the down is in three rows, one above each eye socket, these converging in front, and the third across the occipital region.

Juvenal plumage.—Above, the young bird is similar to the adult female. The general coloration is Lilac Gray (Ridgway, 1912), darker dorsally. The head of the juvenile is lighter than that of the female, the former having more bluish gray, and there is no indication of the light gray saddle as in the adults. The adult occiput is darker, nearer Pallid Mouse Gray. The juvenal marginal coverts are edged with pink as in the adult, but these do not develop fully enough to show when the wing is folded, until just prior to the postjuvenal molt. The contour feathers have brownish edges but are darker centrally, the gray basal portions being more extensive and making the back appear somewhat lighter. The juvenal nasal tufts are whitish as in the adults. The remiges and rectrices are darker than those of the female, being in this respect more nearly like the male. The juvenal secondaries show broad buffy margins and the central rectrices have a narrow margin of a similar color. The remaining rectrices and especially the primaries show distinct but narrow whitish margins. The outer margins of the primaries and their coverts have a narrow band of pink. On the first two or three secondaries this color gradually changes to buffy brown. Ventrally the bird is a uniform bluish gray with the cinnamon-buff tips to the barbs superimposing on this a faint buffy color.

Molt.—Because of the incomplete postjuvenal molt, birds in the first winter plumage can be distinguished from adults. Juvenal wing and tail feathers are retained. These have less extensive white edgings, especially near the tips, and less pink on the outer margins of the feathers. This color is most pronounced in adults along the bend of the folded wing where the overlapping primaries, secondaries and their coverts make an almost solid area of pink. In late winter or early spring, after the feathers have undergone considerable wear, the intensity (not the shade) of pink in this region may be the only way to distinguish between first winter and fully adult birds. The breeding dress results from such wear.

The postnuptial molt was followed almost feather by feather in a captive bird and observed in eighteen molting specimens collected. The molt of the flight feathers in the captive bird was slightly asymmetric, the right wing being slightly advanced over the left in development of a particular feather. One bird collected in the field was similarly asymmetric. The earliest dates on which wild birds were found molting were August 15, 1952, in the Absaroka Range of Wyoming and August 16, 1953, in the Bitterroot Mountains of Montana.

The molt is initiated almost simultaneously on the head, the sides of the breast and the wing primaries. Replacement proceeds from inner primaries to outer,

a single feather being about half grown before the adjacent one falls. The molt of the secondaries apparently begins with the proximal feathers and is followed closely by the distal ones. Replacement then proceeds rather rapidly from both directions toward the middle. Secondary number one is lost at about the time primary six is half developed and before primary seven is lost. The molt of the secondaries is completed at about the same time as that of the primaries.

The greater secondary coverts are being replaced by the time the third and fourth primaries are developing. They develop nearly simultaneously and well in advance of the replacement of the secondaries. The marginal, median and lesser coverts begin replacement after the greater coverts are well developed. Replacement begins centrally and progresses toward both anterior and posterior margins of the wing, and is completed at the time the last primary is being replaced. The feathers of the alula and the under wing coverts are molted at about the time primary seven is shed.

The rectrices are lost in pairs, the corresponding feathers on opposite sides being shed and replaced together. This begins at the time primary five is shed. When these are half grown the next pair drops out. This continues, the outermost pair being the last to be replaced and is completed at about the same time as the molt of the primaries. The middle four rectrices were molted simultaneously in the captive bird and in at least one of the specimens collected. The tail coverts are replaced along with the rectrices.

The back of the crown is probably the first area to show the molt. This is followed by molting on each side of the breast, then on the femoral tract and the thoracic region of the dorsal tract. Feather replacement is under way in all these regions by the time the fourth primary is breaking from its sheath. From these centers the molt spreads over the body. This process continues slowly on the head until about the time when replacement of the secondaries begins. Then feather replacement on the head seems to accelerate. The sides of the head and neck are the last regions of this area to complete the molt.

Effect of captivity on pink color.—When the young birds raised in captivity underwent the postjuvenile molt they failed to develop the normal red pigmentation, but showed buffy instead. The failure of this color to develop in various captive finches has been noted (Arvey, 1938: 263) and has been attributed to diet. Germinating seeds were added to the diet of dry seeds given to the young birds with no apparent effect upon the color of the new feathers. A male Black Rosy Finch trapped in late November and retained in captivity began to molt in March. This bird, normally pigmented prior to the molt, failed to develop the red color and, after molting, resembled the young birds reared in captivity.

Variation of pink color in wild birds.—Color variation has also been observed in nature. Six males collected in the same locality in August, 1953, in the Wind River Range show variation from Strawberry Pink to Rose Doree. Two female specimens from the Uinta Mountains have a light Salmon-Orange color very similar to that shown in the captive birds. In other females from the same locality the pink is better developed (Geranium Pink) (nomenclature of Ridgway, 1912).

There may be some difference in the intensity of this color due to age. A series of young males just completing the postjuvenile molt has the pink paler than two adults completing the postnuptial molt. In addition, there is a change in this color during the winter. The pink is softer or paler in the fresh winter plumage and becomes more intense at the approach of the breeding season. This is probably due to the wearing off of a thin film of barbules on the feathers.

Other members of the Fringillidae are known to change plumage color under unusual conditions. The red color is particularly affected in captivity (see Mayr, 1942: 60) and sometimes in nature (see Michener and Michener, 1931 and 1932). Howell (1952: 244) called attention to the fact that almost all of the red pigments in birds are carotinoids and that birds have never been shown to be capable of synthesizing these pigments. Evidence seems to indicate that they are acquired in the diet (Arvey, *loc. cit.*). Observations on rosy finches seem to suggest not only sexual variation but also individual variation either in diet or in the physiological processes necessary for absorption and deposition of these materials.

Color of bill.—In breeding rosy finches the bill is solid black. In winter birds the bill is yellow, only the tips showing some black. The transition to the breeding condition begins in the Black Rosy Finch before the end of February. Pigmentation begins at the tip and gradually spreads to the base. By the end of March, at about the time of spring migration, nearly all of the bill has darkened except at the angles of the commissure, where some yellow may remain. The darkened portions at this time, however, are not the intense black color that is found in breeding birds. Pigment deposition continues until the solid color is attained.

Not all birds have the bills at the same stage of pigmentation. In general, *L.t. littoralis* and *L.t. tephrocotis* are about two weeks behind *atrata* in amount and intensity of bill pigmentation in the spring. Near the end of July or early August the reverse transition in color of the bill begins. At first the bill begins to turn yellowish at the base and this progresses distally. By the time the post-nuptial molt is complete, less than half of the bill remains black. When the birds arrive on the wintering grounds, the bills are in typical winter condition.

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SUMMARY

An account of the breeding activities of the Black Rosy Finch *Leucosticte tephrocotis atrata* is given. The territory centers around the female bird. The nest is usually situated in a small cavity on a vertical cliff. Four or five eggs are laid early in June. The female alone builds the nest and incubates the eggs. Incubation lasts twelve to fourteen days. Both parents feed the young, which leave the nest at approximately twenty days of age. Feeding by adults continues as long as two weeks after the young leave the nest. Family groups soon join together to form flocks. The call notes of the Black Rosy Finch

are described. These birds are considered songless, as the "song" is a primitive or unspecialized effort.

The seeds of three genera of alpine plants formed the major food of the rosy finches, with animal matter being taken occasionally, but especially when the young are being fed. The advent of breeding may be correlated with the insect supply.

Flocking behavior is discussed. The birds concentrate in large flocks during the winter and utilize the same buildings or caves for roosting year after year.

All available evidence indicates that males outnumber females by approximately six to one. This is believed to be the main factor limiting increase of population of the species.

The Black Rosy Finch is the only member of the genus in North America that shows strong sexual dimorphism. Molts and immature plumages are described. Considerable variation in red pigmentation was noted. The bill becomes darkly pigmented during the breeding season but is yellow at other times.

LITERATURE CITED

- AMERICAN ORNITHOLOGISTS' UNION. 1957. Check-list of North American Birds. Fifth Ed. 691 pp.
- ARVEY, D. 1938. Color changes in a captive Cassin purple finch. *Condor*, 40: 263.
- BEHLE, W. H. 1944. Notes on *Leucostictes* wintering in Salt Lake Valley, Utah. *Condor*, 46: 207-208.
- CAHN, A. R. 1947. Notes on the birds of the Dutch Harbor area of the Aleutian Islands. *Condor*, 49: 78-82.
- DAWSON, W. L. 1923. The birds of California. Vol. 1. San Diego, Los Angeles and San Francisco, South Moulton Company. xvii + 522 pp.
- FRENCH, N. R. 1955. Foraging behavior and predation by Clark Nutcracker. *Condor* 57: 61-62.
- FRENCH, N. R. 1959. Distribution and migration of the Black Rosy Finch. *Condor*, 61: 18-29.
- HANNA, G. D. 1922. The Aleutian Rosy Finch. *Condor*, 24: 88-91.
- HOWELL, T. R. 1952. Natural History and differentiation in the Yellow-bellied Sapsucker. *Condor*, 54: 237-282.
- LEFFINGWELL, D. J. AND A. M. LEFFINGWELL. 1931. Winter habits of the Hepburn Rosy Finch at Clarkston, Washington. *Condor*, 33: 140-150.
- LORENZ, K. Z. 1937. The companion in the bird's world. *Auk*, 54: 245-273.
- MAYR, E. 1942. Systematics and the origin of species. New York, Columbia University Press. xvi + 334 pp.
- MICHENER, H. AND J. R. MICHENER. 1931. Variation in color of male House Finches. *Condor*, 33: 12-19.
- MICHENER, H. AND J. R. MICHENER. 1932. Colors induced in male House Finches by repeated feather removals. *Condor*, 34: 253-256.
- MILLER, F. W. 1925. The nest and eggs of the Black Rosy Finch. *Condor*, 27: 3-7.

- MILLER, A. H. AND H. TWINING. 1943. Winter visitant rosy finches in north-eastern California. *Condor*, 45: 78.
- NICE, M. M. 1943. Studies in the life history of the Song Sparrow, II. *Trans. Linn. Soc. N. Y.*, 6: 1-328.
- RIDGWAY, R. 1912. Color standards and color nomenclature. Published by the author. viii + 43 pp.
- TWINING, H. 1938. The significance of combat in male rosy finches. *Condor*, 40: 246-247.
- TWINING, H. 1940. Foraging behavior and survival in the Sierra Nevada Rosy Finch. *Condor*, 42: 64-72.
- U. S. Atomic Energy Commission, Idaho Falls, Idaho.*