AGING AND SEXING SNOWY OWLS

By Bertie Josephson

INTRODUCTION

Because female Snowy Owls (*Nyctea scandiaca*) tend to be darker than males, and birds that are less than one year old tend to be darker than adults (Ridgway, 1914; Bent, 1938; Witherby et al., 1952; Keith, 1960; Dement'ev et al., 1966), at least four Snowy Owl plumage classes are recognized: first-year females, first-year males, adult females, and adult males. The darkest birds are likely to be first-year females, whereas adult males always have very light plumage. However, the two remaining classes, first-year males and adult females, are intermediate in plumage characteristics and are less easily distinguished by means of plumage. Because relatively light plumage may indicate a male bird or an adult, and dark plumage may characterize a female or a bird in its first basic (first-year) plumage, it is difficult to age Snowy Owls unless sex is known and vice versa. Keith (1960) used the presence of a cloacal bursa (bursa of Fabricius) as a criterion of first-year status and compared the relative lightness of plumage in male and female first-year Snowy Owls. He concluded that, although immatures could be sexed on the basis of plumage fairly accurately, "it would seem unwise . . . to attempt to utilize plumage characters as a means of field-sexing populations known to contain both juvenile and adult age groups" (1960: 109). The objectives of the present study are to describe the plumage characters and relative sizes of first-year males, first-year females, adult males, and adult females and the degree of overlap among these classes.

METHODS

From game agents and museums in the United States and Canada 33 Snowy Owl specimens were obtained. One owl was received from Massachusetts; the others came from western Canada (Manitoba to British Columbia) and Washington. The owls had been secured from October through April between 1972 and 1976. All had either been found dead, died in captivity, or been confiscated after being illegally killed. Consequently, it was not known how long many of the owls had been dead. Furthermore, many of the carcasses were partially decomposed. For these reasons, dates of death and reliable weight data were unobtainable. Specimens were examined for the presence of a cloacal bursa, which was probed both before and after dissection of the cloaca. Measurements of the length of the bursa from the anterior end of the organ to its opening into the proctodeum were used; measurements of this distance were more consistent than measurements from the anterior end of the bursa to the lips of the cloaca. On the basis of bursal measurements, birds were classified as first-year, adult (at least one year old), or of unknown age.

An estimate of the width of ventral plumage barring was computed

by measuring the width at the rachis of 15 bars on feathers selected from all four quadrants of the breast and belly and by averaging these figures. The number of bars per ventral feather was counted for 15 breast feathers and averaged to give an estimate of the density of ventral barring.

Two-tailed Student's *t* tests were applied to figures for wing chord, length of center rectrices, and width and density of ventral barring to determine the significance of differences between age and sex classes.

The owls used in this study were prepared as study skins which were deposited in the following museums: Charles R. Conner Museum, Washington State University, Pullman; British Columbia Provincial Museum, Victoria; Museum of Natural History, Regina.

RESULTS AND DISCUSSION

Bursa Size

Keith (1960) plotted the relationship between bursal length and date for Snowy Owls collected from mid-November to mid-January and calculated that the bursa shortened at a rate of about 0.28 mm/day. Assuming that the rate of involution of the bursa remains fairly constant, Keith concluded that the bursa in Snowy Owls would be completely resorbed by the end of April of the first year of life. If this is correct, then the presence of a bursa in a Snowy Owl can be used as an indication of first-year status. I have been unable to find any other data on bursal regression in Snowy Owls. It is not known whether the bursa is completely resorbed in adult Snowy Owls. It was not possible to determine the relationship between bursal length and date for the birds examined in this study, because dates of death were unavailable or inexact for many specimens and because the state of decomposition of the carcasses varied.

The owls examined in this study could be separated into four categories on the basis of bursal size. A prominent bursa, measuring at least 12 mm, was found in 17 birds. In them, the bursal opening into the proctodeum was conspicuous and easily probed in the undissected bird. Bursae of less than 12 mm were narrow and lacked a prominent opening. Often the opening of such a bursa was not discovered in the undissected cloaca. Upon dissection, it was found that the bursa would not admit a probe initially, but, after being teased apart, such bursae measured 5–11 mm. Bursae of this type were found in five specimens. In six birds no bursa was present. Five birds possessed small, cuplike bursal remnants of 2–3 mm. Two specimens in the latter category lacked dates; the dates on the other three ranged from October through February.

Because it is not known when bursal involution in Snowy Owls is completed, only the 17 birds with prominent bursae were assumed to be less than one year old. Owls lacking a bursa entirely or possessing a bursal remnant of 2–3 mm were presumed to be more than one year old. These birds are referred to in this paper as adults. Birds with bursae

TABLE 1.

Wing and tail measurements of Snowy Owls.

Measurement	Age	Females *n*	Females Mean ± SD (range)	Males *n*	Males Mean ± SD (range)
Wing chord (mm)	First-year	7	420.3 ± 14.9 (398–446)	10	381.1 ± 17.3 (351–410)
	Adult	8	418.4 ± 15.4 (396–443)	3	385.7 ± 10.0 (378–397)
	Age unknown	2	393.5 (380–407)	3	371.3 ± 10.6 (360–381)
TOTAL		17	416.2 ± 16.8 (380–446)	16	380.1 ± 15.2 (351–410)
Tail length (mm)	First-year	7	229.3 ± 7.8 (219–239)	10	210.4 ± 7.3 (203–221)
	Adult	6	228.2 ± 6.8 (216–235)	3	210.0 ± 5.3 (206–216)
	Age unknown	2	226.5 (225–228)	3	206.3 ± 11.2 (194–216)
TOTAL		15	228.5 ± 6.6 (216–239)	16	209.6 ± 7.4 (194–221)

of 5–11 mm were not used in formulating descriptions of plumage characteristics.

Wing and Tail Measurements

First-year owls and adults of the same sex did not differ significantly in wing length or in length of center rectrices ($P > .10$; Table 1). Wing and tail lengths were both significantly larger for females than for males, regardless of age ($P < .01$ in all cases). Tail measurements showed less overlap than wing chord measurements.

Criteria for sex-determination based on wing and tail lengths and the percentage of the owls in this study correctly identified using these criteria are shown in Table 2. Although size differences can aid in sexing Snowy Owls in the hand, birds should not be sexed on the basis of these measurements alone until the roles of feather wear and geographic size variations in this species are clarified.

Plumage Characteristics

Determination of Age by Inspection of Nape.—Some writers have suggested that it is possible to distinguish first-year from adult Snowy Owls by examining the plumage at the nape. Bent (1938) and Keith (1960) both refer to a patch of drab down present on immature Snowy Owls beneath the contour feathers of the neck. Bent states that remnants of the "drab

TABLE 2.
Size criteria for sexing Snowy Owls.

Criterion of sex	Classes		Percent correctly identified		Percent not identifiable		Percent misidentified	
	Male	Female	Male	Female	Male	Female	Male	Female
Wing chord[1]	≤398 mm	≥404 mm	94	82	0	0	6	18
Length of center rectrices[2]	≤219 mm	≥221 mm	94	87	0	0	6	13
Combination of wing chord and length of center rectrices[2]	≤398 mm ≤219 mm	≥404 mm ≥221 mm	87	67	13	33	0	0

[1] Based on 16 males and 17 females.
[2] Based on 16 males and 15 females.

juvenal down" at the neck persist "early in the season, at least, and perhaps later" (1938: 363–364). Keith reported finding such a patch of down beneath the contour feathers of the neck in first-year birds collected between November and January. I was unable to find a patch of down that could be used as a diagnostic characteristic for first-year Snowy Owls. The proximal portions of the neck feathers on all owls examined were gray or brownish-gray and downy. I was not able to discern any patch of down distinct from these downy feather bases.

Witherby et al. describe "a small patch of heavily barred feathers" present at the center of the nape of first-year males but absent in adult females (1952: 311). A patch of heavily barred feathers was present in the first-year males and first-year females examined in this study and absent in adult males. However, this characteristic was sometimes quite difficult to identify with certainty. Furthermore, adult females frequently possessed a similar patch of barred feathers at the nape. Therefore, although a heavily barred patch at the nape might be useful in separating first-year males from adult males, this trait does not seem reliable as a means of distinguishing first-year males from adult females.

Mottling.—According to Witherby et al., Snowy Owls in their first winter show "mottling" on the "greater coverts," "primary coverts," and "tips of inner secondaries" (1952: 311). Mottling, in the form of brown or gray dappling of the remiges and coverts, was found in all first-year birds examined in this study (Figs. 1A, C; 3E, G). These markings, present on the distal portions of outer primaries, inner secondaries, greater primary coverts, greater secondary coverts, median secondary coverts, and alular quills, ranged from a few gray or brown flecks to extensive splotches and sometimes covered much of the wings and back, obscuring the pattern of barring. Dark, extensive mottling was found

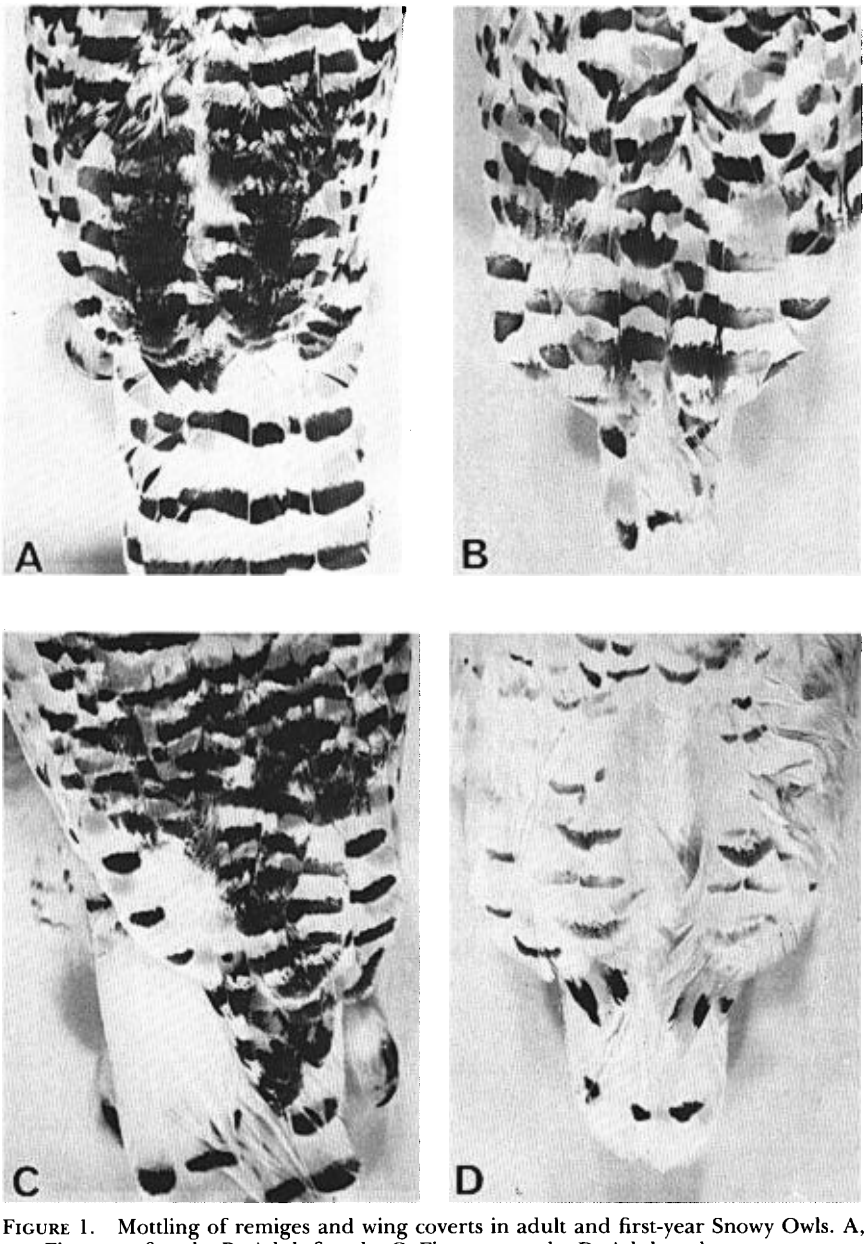

FIGURE 1. Mottling of remiges and wing coverts in adult and first-year Snowy Owls. A, First-year female. B, Adult female. C, First-year male. D, Adult male.

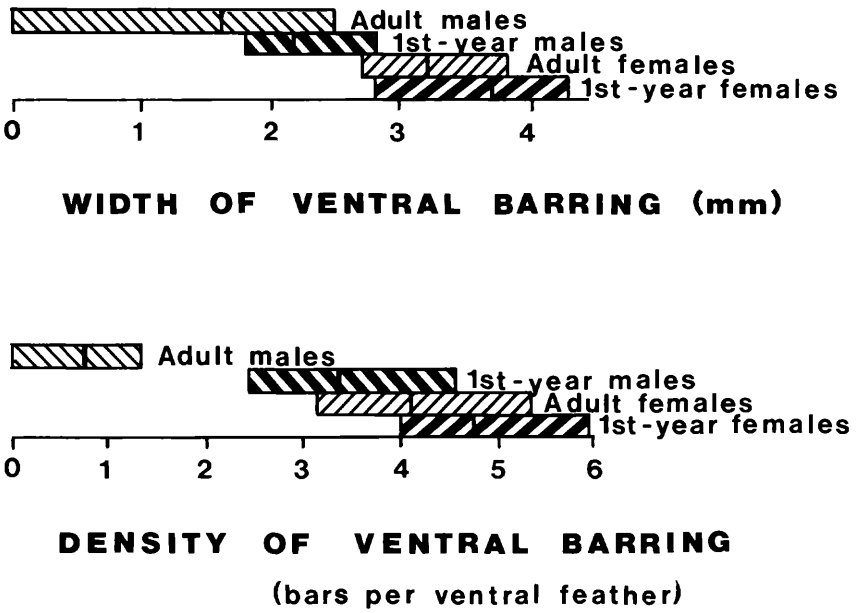

FIGURE 2. Width and density of ventral barring in 33 Snowy Owls. Vertical lines indicate means.

in some first-year males and first-year females and was absent in all adults. The amount of mottling seen in first-year birds was roughly correlated with overall darkness of plumage.

Although the presence of dark, extensive mottling indicates a first-year bird, flecks and splotches of dark color on the remiges and wing coverts were not restricted to first-year birds. Most adult females showed slight mottling of the greater primary coverts and of the distal tips of the primaries. Furthermore, in some first-year birds of both sexes the amount of mottling was slight and comparable to the amount of mottling noted in adults of the same sex.

Width and Density of Ventral Barring.—Preble (1908) reported that barring of the breast was much thicker in female than in male Snowy Owls. In the present study, females had significantly thicker barring than males ($P < .05$ for adults; $P < .001$ for first-year birds and for all males compared to all females; Fig. 2). First-year birds tended to have thicker barring than adults of the same sex although the difference was not significant at the 5% level ($.10 > P > .05$). Density of barring on breast and belly was similarly related to sex and age, with adult males having sparser markings than first-year males ($P < .001$) and females showing a slight but insignificant difference in density of barring with age ($P > .10$). Similarly, females had significantly denser barring than males, regardless of age ($P < .01$ in all cases). First-year males had narrower bars

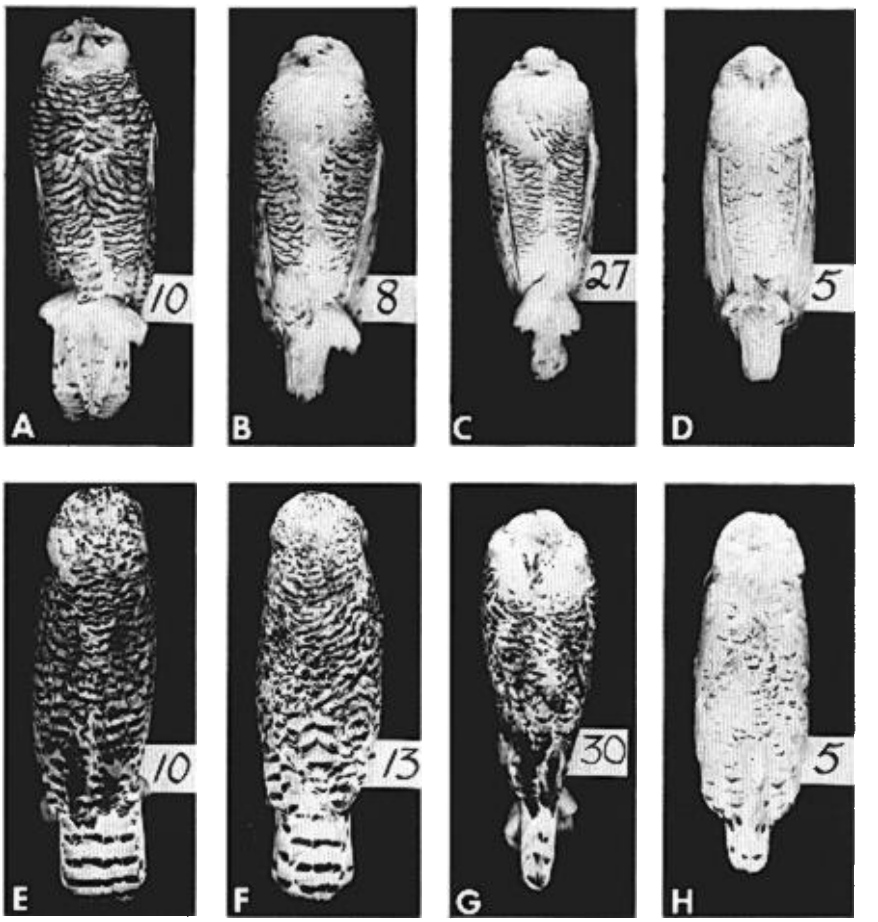

FIGURE 3. Snowy Owl plumage classes. A, E, First-year female. B, F, Adult female. C, G, First-year male. D, H, Adult male. Note mottling of back of first-year male (G) and first-year female (E).

than adult females ($P < .001$) and were somewhat more sparsely barred than adult females ($P = .05$).

Extent of Barring.—The most extensive barring occurred in first-year females (Fig. 3A, E). In the most heavily barred individuals of this group the only unbarred areas of the plumage were the facial disk, the tarsi and feet, and the wing linings. In lighter specimens, barring was absent from parts of the top, sides, and back of the head, and a white bib (extending from the facial disk to the first medial bar of the breast plumage) measured up to 4 cm. All the first-year females examined in this study had barring on the crissum. With the exception of one first-

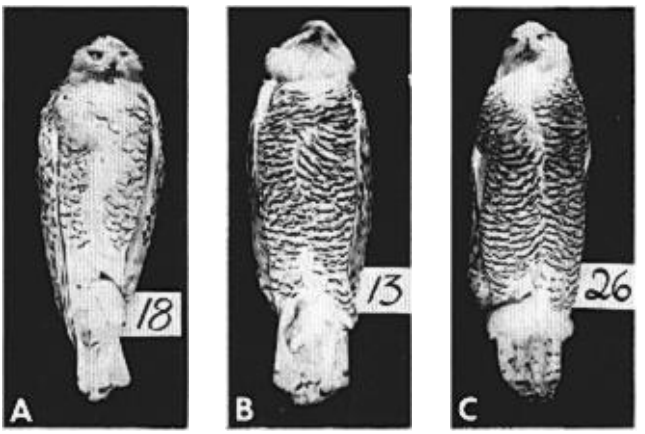

FIGURE 4. Comparison of adult and first-year female Snowy Owls. A, B, Adult females. C, First-year female. Note variation in extent of barring in adult females and similarity between B and C.

year female which had fewer than six bars on the entire crissum, all the owls in this group had prominent barring, with several bars per under tail covert, on most of the crissum (Fig. 3A).

Adult females showed considerable variation in the extent of barring (Figs. 3B, F; 4A, B). In the darkest adult females the white bib was absent, whereas in lighter individuals bibs up to 8 cm in length were found. Although dense barring sometimes covered the top and sides of the head, barring of the back of the head was always absent or sparse. The heavily barred crissum found in most first-year females was not seen in adult females; the crissum of adult females was either white or had a total of fewer than six bars.

The plumage of typical first-year male Snowy Owls is illustrated in Fig. 3C and G. The barring of first-year males was usually extensive, but in one specimen it was quite sparse. The length of the bib varied from 2 to 8 cm. The back of the head in first-year males as in adult females was partially barred or unbarred. The crissum was usually white or slightly barred. One specimen showed dark barring of the crissum similar to that seen in immature females.

One adult male was nearly immaculate; the other two adult males examined had narrow, pale, sparse barring on head, belly, and back (Fig. 3D, H). The length of the bib in adult males was at least 10 cm in all cases. The crissum was always white.

Distinguishing Plumage Classes.—First-year females and adult females: Whereas first-year females as a group have somewhat denser, more extensive barring than adult females, some adult females are as darkly barred as first-year birds of the same sex (Figs. 2; 4B, C). If present,

conspicuous, extensive mottling of the remiges and wing coverts can be used to distinguish first-year females from adults, but relatively light first-year females and the darkest adult females tend to show about the same amount of mottling. Although the presence of a heavily barred crissum or of extensive mottling of the greater secondary coverts may help to identify some female Snowy Owls as first-year birds, the absence of mottling or of a densely barred crissum is not diagnostic for adults. The plumage at the back of the head was useful in aging the females handled in this study. In adult females, unbarred areas at the back of the head were more extensive than barred areas. In first-year females, the barred areas were always more extensive than the areas lacking barring. Three of the females of known age (20%) were intermediate in extent of barring on the breast and back and in amount of mottling, but all three could be correctly aged on the basis of barring on the back of the head and on the crissum.

First-year males and adult females: First-year male and adult female Snowy Owls show considerable overlap in plumage characteristics. Size is often a useful clue to sex of the bird (Tables 1 and 2 and Fig. 3). Furthermore, the darker first-year males (the ones most likely to be confused with adult females) show extensive mottling that would not be found in adult females (Figs. 1B, C; 3F, G). Finally, the ventral barring of first-year males is usually considerably thinner than that of adult females, although some overlap does occur.

First-year males and adult males: In most cases, confusion between the very light plumage of adult males and the darker, more heavily mottled plumage of first-year males is unlikely to occur. However, light first-year males may resemble relatively dark adult males. In such cases, any attempt to age male Snowy Owls without bursal measurements or comparison with other specimens is subject to error. One first-year male in this study (8% of the males of known age) had very light plumage resembling that of the adult males. This bird could not be reliably aged on the basis of plumage alone.

Birds of Unknown Age

The five Snowy Owls of unknown age, possessing narrow bursae of 5–11 mm, are shown in Fig. 5. These specimens show a few plumage characteristics of first-year Snowy Owls and many traits typical of adults. One male (5D, I) showed an amount of mottling similar to that seen in the lightest first-year male. Another male in this group (5E, J) had a few densely barred feathers at the nape. In most respects, however, the plumage of these birds was characteristic of adults. One male of unknown age (Fig. 5C, H), with a 7-mm bursa, was nearly immaculate, with much lighter plumage than two of the three adult males examined. These observations suggest that these birds are in their second year of life and that the plumage of second-year Snowy Owls retains characteristics of the first basic plumage to a variable extent while displaying many features typical of adults. Thus, it is unclear whether the second-

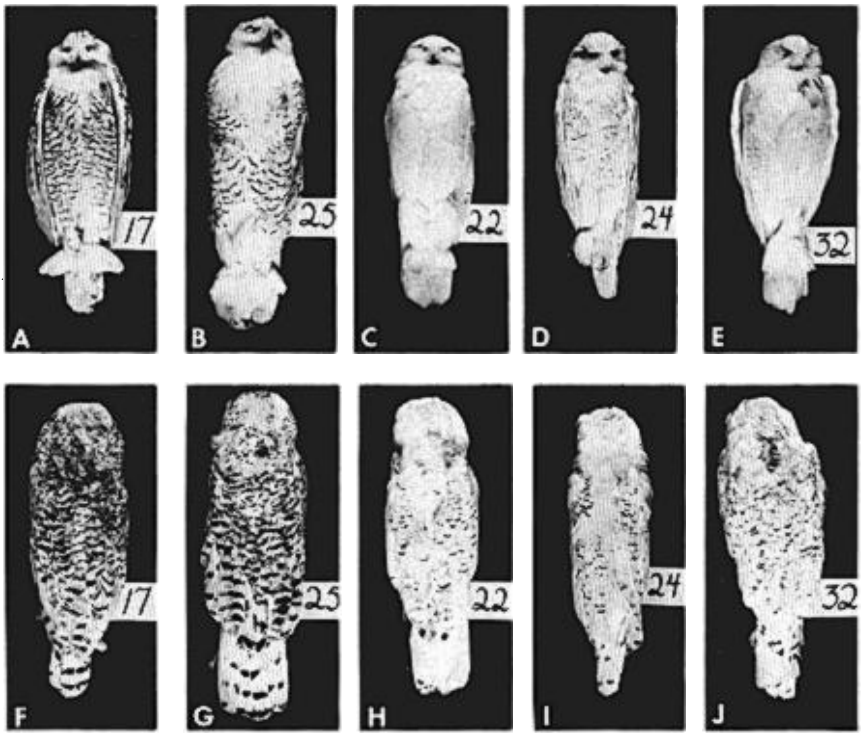

FIGURE 5. Snowy Owls possessing bursal remnants of 5–11 mm. A, B, F, G, Females. C, D, E, H, I, J, Males.

year plumage of Snowy Owls should be considered the definitive plumage for this species (Dement'ev et al., 1966) or a second basic plumage.

Witherby et al. contend that "there is no proof that birds get whiter after their 2nd winter" (1952: 311). However, the possibility that females, at least, do not attain their lightest plumage during their second year is suggested by the variations in plumage among adult females seen in this study. Among the adult females examined, the birds possessing bursal remnants of 2–3 mm were considerably darker and more difficult to distinguish from first-year birds than were those females in which the bursa had completely regressed. This was not the case for the males with bursal remnants. In some species, such as the Mallard (*Anas platyrhynchos*), bursal remnants persist in adult birds (Höhn, 1956). Johnston (1956) found that breeding third-year California Gulls (*Larus californicus*) had smaller bursae than nonbreeding birds of the same age. It is not known whether these bursal remnants in Snowy Owls persist or eventually disappear. Therefore, it is unclear whether the birds with bursal remnants were younger than those birds in which the bursa had been completely resorbed. However, these observations lead to the speculation that the females with bursal remnants have not yet attained their

definitive plumage and are younger than those birds in which involution has been completed.

Data on Snowy Owls of known age would be extremely useful for determining the age at which the definitive plumage is attained and the fate of bursal remnants in adults of this species.

SUMMARY

The following key for aging and sexing Snowy Owls was developed on the basis of 33 owls obtained from October through April:

1a. Barring present on all areas of plumage except for white facial disk, tarsi, feet, and wing linings ..... FIRST-YEAR FEMALE
1b. Barring absent from parts of head or breast or other areas besides facial disk, tarsi, feet, and wing linings 2
2a. Plumage entirely white or white except for narrow, sparse, pale gray or brown barring on breast, back, wings, head, and/or tail ..... ADULT MALE
2b. Moderate or extensive barring present on breast, wings, head, and/or tail 3
3a. Moderate or extensive mottling present on distal portions of greater and/or median secondary coverts 4
3b. Mottling absent from distal portions of greater and/or median secondary coverts or very slight mottling present 5
4a. White bib of 2–8 cm present and back of head primarily white ..... FIRST-YEAR MALE
4b. White bib, if present, ≤4 cm and back of head primarily barred ..... FIRST-YEAR FEMALE
5a. White bib of ≤8 cm present and/or back of head primarily white ..... ADULT FEMALE
5b. White bib absent or ≤4 cm and back of head primarily barred 6
6a. Crissum with >6 bars ..... FIRST-YEAR FEMALE
6b. Crissum white or with few (≤6) bars or spots ..... FEMALE, AGE UNDETERMINED

Of the birds of known age in this study, one male of 13 (8%) could not be accurately aged with this key. All females of known age used in this study could be aged correctly by means of this key, but in some cases females for which age could not be determined using this key might be encountered.

The Snowy Owls with bursae of 5–11 mm would be classified as adults using the key presented above.

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LITERATURE CITED

BENT, A. C. 1938. Life histories of North American birds of prey. Part II. *U.S. Natl. Mus. Bull.* 170.

DEMENT'EV, G. P., N. A. GLADKOV, E. S. PTUSHENKO, E. P. SPANGENBERG, AND A. M. SUDILOVSKAYA. 1966. Birds of the Soviet Union, Vol. 1 (G. P. Dement'ev and N. A. Gladkov, eds.). Jerusalem, Israel Program for Scientific Translations (transl. A. Birron and Z. S. Cole).

HÖHN, E. O. 1956. Seasonal recrudescence of the thymus in adult birds. *Can. J. Biochem. Physiol.*, **34:** 90–101.

JOHNSTON, D. W. 1956. The annual reproductive cycle of the California Gull. I. Criteria of age and the testis cycle. *Condor,* **58:** 134–162.

KEITH, L. B. 1960. Observations on Snowy Owls at Delta, Manitoba. *Can. Field-Nat.,* **74:** 106–112.

PREBLE, E. A. 1908. A biological investigation of the Athabaska-Mackenzie region. *North Amer. Fauna,* 27.

RIDGWAY, R. 1914. The Birds of North and Middle America. Part VI. *U.S. Natl. Mus. Bull.* 50.

WITHERBY, H. F., F. C. R. JOURDAIN, N. F. TICEHURST, AND B. W. TUCKER. 1952. Handbook of British Birds, Vol. 2 (H. F. Witherby, ed.). London, H. F. and G. Witherby.

Department of Zoology, Washington State University, Pullman, WA 99164. (Present address: Program in General Biology, Washington State University, Pullman, WA 99164). Received 17 November 1979, accepted 24 January 1980.