

PIED PLUMAGE IN BALD EAGLES

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Abstract.—Nestling and adult Bald Eagles (*Haliaeetus leucocephalus*) banded and observed in the Greater Yellowstone region of northwestern Wyoming and southeastern Idaho displayed previously unrecorded plumage and talon coloration. Atypical characteristics were noted in nine nestling and three adult Bald Eagles associated with the Snake River watershed between 1979 and 1989. Atypical plumage in nestlings was characteristic of genetically based pied plumage (i.e., feathers either completely white or completely brown, not diluted, speckled, or partially albino). Pied plumage in nestlings was manifested as one or all of the following abnormal characteristics: a wedge of white feathers on the crown, white breast patch, white chin, abdomen, and crissum feathers, white epaulets, and in one case, a completely white primary feather. One parent of a brood of affected nestlings exhibited atypical characteristics while parents of another brood were normal. Pied plumage of adults was characterized by small white breast patches, white feathers on the lateral crus, white feathers on the leading edge of the patagium, and/or white epaulets. Similar atypical plumage and talons were recorded in Golden Eagles. Pied plumage was expressed only in female Bald Eagles and was associated with white (normally black) talons in both nestlings and adults and partially yellow (normally all black) cere in nestlings. Pied plumage may be masked in definitive plumage of Bald Eagles or at least not obvious when viewed from a distance. Pied plumage in nestling Bald Eagles may be unique to Greater Yellowstone and proximity of affected eagles exhibiting pied plumage indicated close genetic relationship among resident breeding pairs.

COLORACIÓN ATENUADA EN *HALIAEETUS LEUCOCEPHALUS*

Sinopsis.—Pichones y adultos de *Haliaeetus leucocephalus* marcados y observados en la región del "Greater Yellowstone" del noroeste de Wyoming y del sureste de Idaho mostraron una coloración de plumaje y de talones previamente desconocida. Entre 1979 y 1989 se detectó la coloración atípica en 9 pichones y en 3 adultos de *Haliaeetus leucocephalus* asociados con la cuenca del Río "Snake." El plumaje atípico en los pichones era característico de plumaje atenuado genéticamente basado, e.g., plumas ya sean totalmente blancas o totalmente marrones, no diluidas, moteadas, o parcialmente albinas. El plumaje atenuado en pichones consistió en uno o todos de las siguientes características, una cuña de plumas blancas en la cabeza, un parcho blanco en el pecho, plumas ventrales blancas, atenuadamente blancas, y en un caso, una primaria completamente blanca. Un padre de una cría exhibió características atípicas, mientras los padres de otra eran normales. El plumaje atenuado de adultos se caracterizó por pequeños parchos blancos en el pecho, plumas blancas en los laterales de la cola, plumas blancas en la esquina principal del patagio, y por espolones blancas. Un plumaje similarmente atípico y talones se registraron en individuos de *Aquila chrysaetos*. El plumaje atenuado se expersó solo en hembras de *Haliaeetus leucocephalus* y se asoció a talones blancos (normalmente negros) tanto en pichones como en adultos y el cere parcialmente amarillo (normalmente negro en su totalidad) en pichones. El plumaje atenuado se puede disfrazar

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en el plumaje definitivo de *Haliaeetus leucocephalus* o por lo menos no tan obvio al verlo a la distancia. El plumaje atenuado en *Haliaeetus leucocephalus* puede ser único al "Greater Yellowstone" y la proximidad de aves exhibiendo este plumaje indicar gran cercanía genética entre las parejas residentes que anidan.

Age-related plumage variation of Bald Eagles has been well documented (Bent 1937; Clark 1983; Gerrard et al. 1978; McCollough 1989; Southern 1964, 1967), but descriptions of atypical plumages are rare (Clark and Wheeler 1987). No unusual plumages were noted in over 500 wild Bald Eagles captured in different regions of western North America (Harmata and Stahlecker 1993, Harmata and Restani 1995, Hodges et al. 1987, McClelland et al. 1994) and no unusual plumages were noted among 2331 Bald Eagles of all age (plumage) classes examined by the National Wildlife Health Research Center, U.S. Fish and Wildlife Service, Madison, Wisconsin (N. Thomas, pers. comm.).

"Diluted" adult plumage has been described (Clark and Wheeler 1987) and a "partial albino" Bald Eagle was associated with autumn concentrations of Bald Eagles in Glacier National Park each year from 1978–1988 (B. R. McClelland, pers. comm.). Additionally, a Bald Eagle appearing totally white from a distance was found to be partial albino after capture near Haines, Alaska in 1981 (S. Cain, pers. comm.). Clearly, atypical or aberrant plumage is rare. Therefore, we describe unusual plumage and talon coloration observed in nestling and adult Bald Eagles.

STUDY AREA AND METHODS

Bald Eagle plumages were observed throughout the Greater Yellowstone region of northwestern Wyoming, southwestern Montana, and southeastern Idaho. Greater Yellowstone encompasses about 16,000 km² and includes Yellowstone National Park and Grand Teton National Park. Habitat and Bald Eagle population characteristics are described in the Greater Yellowstone Bald Eagle Management Plan (Greater Yellowstone Bald Eagle Working Group 1996).

Between June 1979 and August 1989, nestling Bald Eagles were banded with U.S. Fish & Wildlife Service "pop-rievet" bands and colorbands throughout Greater Yellowstone. Most effort was directed at nests associated with the Snake River watershed in northwestern Wyoming and eastern Idaho. All eaglets were banded at >6.5 wk of age. Adult Bald Eagles were captured in the Wyoming portion of Greater Yellowstone beginning in June 1985. Sex was assigned by bill depth measurement. Eaglets with bill depths below the upper 95% confidence limit of male bill depth measurement of eaglets of appropriate age presented by Bortolotti (1984) were considered males, the rest females. Adult eagles were considered males if bill depth ≤ 33.0 mm, the rest were considered females (Garcelon et al. 1985).

RESULTS

Plumage and talon coloration of nestlings.—A total of 257 nestling Bald Eagles was banded in Greater Yellowstone between 1979 and 1989, 85%

TABLE 1. Nestling Bald Eagles banded in nests associated with pied plumage in the Snake River watershed of Greater Yellowstone, 1981–1989.

Breeding pair (state)	Years		Nestlings banded			
	Young banded	With pied nestlings	Male	Female	Unk.	Pied
Oxbow (WY)	3	2	2	1	2	3
Butler Creek (WY)	6	2	5	7		3
Munger Mtn. (WY)	2	1	2	1		1
Triangle X (WY)	2	1	1	2		1
Cress Crk. (ID)	1	1	1	1		1
			11	12	2	9

in the Snake River watershed and 37% in Wyoming. Nine nestlings (3.5% of total) in five nests displayed atypical juvenal plumage (Table 1). The first observation of atypical plumage was on 20 Jun. 1981 during banding operations at the Oxbow nest in Grand Teton National Park (site A, Fig. 1). Both nestlings were at least 7-wk old and appeared to have a white wedge of feathers on the head when observed from the ground through a spotting scope. Only heads of nestlings were visible from the observation point, but white feathers appeared to cover the crown and chin of both. The climber was not a biologist, and these were the first Bald Eagles he handled, so when questioned post-banding, he stated he had not noticed any abnormalities. Because no photos or measurements were taken in the nest, sex was not assigned and further inspection was not possible.

Precise description of an atypical plumage was not accomplished until 17 Jun. 1985 when both nestlings from the Butler Creek nest (site B, Fig. 1) were lowered from the nest for radio-tagging. Both eaglets were at least 8.5-wk old and exhibited the white wedge of head feathers similar to that displayed by nestlings banded at the Oxbow nest in 1981. The apex of the white wedge of feathers on the head emanated from the dorsal proximal cere, progressed across the forehead and crown, and terminated in the anterior occiput region (Fig. 2). The rictus to commissural points and proximal dorsal cere adjacent to white feathers were bright yellow. Additionally, both eaglets had at least 3 white talons (Fig. 3), and white feathers predominated on the abdomen, crissum, chin, and breast. These eaglets were clearly different from normal plumage at that age (e.g., Brown and Amadon 1968; Stalmaster 1986, 1988; Wheeler and Clark 1995).

Five other nestling Bald Eagles distributed among five breeding areas in Greater Yellowstone were known to exhibit atypical plumage during 1986–1989 (Fig. 1). The most notable was a female produced in 1987 at the Munger Mountain nest (site C, Fig. 1). Her plumage was dramatically different from the normal plumage of her brother (Fig. 4). She had much more yellow on the proximal cere than any other nestling encountered, primary 8 on the left wing was totally white, and she displayed white

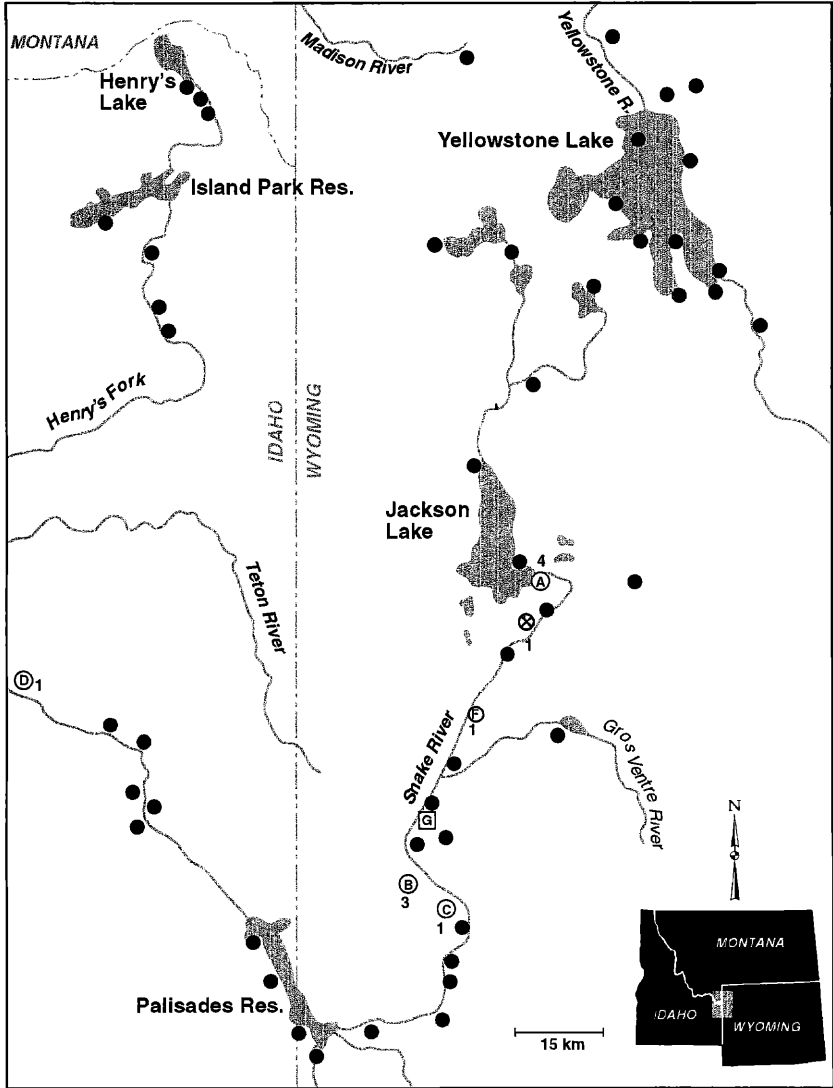


FIGURE 1. Bald Eagle nest sites associated with the Wyoming and Idaho portion of the Greater Yellowstone region. Dots and open circles show nests sites of pairs present in 1989. Open circles with letters indicate nest sites associated with Bald Eagles displaying atypical plumage. Number associated with open circle indicates number of individuals displaying atypical plumage associated with that site. Open square indicates capture site of injured eagle displaying pied plumage.



FIGURE 2. Nestling Bald Eagle displaying pied head plumage. Eaglet was produced at the Butler Creek nest site (site B, Fig. 1) on the Snake River, Wyoming, 1985.



FIGURE 3. White talons of a nestling Bald Eagle displaying pied plumage.



FIGURE 4. Sibling Bald Eagles, Munger Mountain nest site (site C, Fig. 1), Snake River, Wyoming, 1987. Normal plumage male on left.

shoulder feathers (epaulets), downy breast patch, and talons (Fig. 4). Based on observations of the Butler Creek nestlings in 1985, the white down was most likely precursor to white contour feathers on the breast.

Bill depth measurements permitted sex to be assigned to 75% of all nestlings banded; 98 were females and 94 were males. Proportions by sex did not differ from equality ($\chi^2 = 0.083$, $df = 1$, $P = 0.773$). Of nestling eagles displaying atypical plumage that could be assigned sex (seven of nine), all were female. Proportion of nestling eagles displaying atypical plumage by sex differed from equality ($\chi^2 = 6.0$, $df = 1$, $P = 0.014$).

Plumage and talons of parents of affected nestlings.—In April 1986, the adult female at the Butler Creek nest site (site B, Fig. 1) where atypical nestlings were produced the year before, was captured, banded, and radio-tagged. Coloration of her plumage and talons was normal. The adult male also appeared normally colored when observed through binoculars. Behavior and perch site selection of the adult male and colorband of the adult female indicated the same parents were resident at the nest site at least from 1986 to 1989. Of seven nestlings produced during that period, only one female produced in 1987 displayed atypical plumage.

In March 1987, the adult male at the Oxbow site (site A, Fig. 1) where unusual nestling plumages were first noted in 1981, was captured but no unusual plumage was evident. After his death in mid-April from gunshot wounds, he was replaced by another male in March 1988 that was not adequately observed to detect plumage abnormalities. One of two siblings

banded in the Oxbow nest in June 1988 again exhibited atypical color patterns. When captured in August 1988, the adult female at Oxbow site had white epaulets and several white feathers on the lateral crus of both legs. Four talons were also partially colored white. The single nestling produced there in 1989 was a male and did not exhibit atypical plumage. The color banded female that produced young with atypical plumage in 1988 was still present (S. Cain, pers. comm.).

Nestlings with pied plumage also were produced at the Cress Creek nest in Idaho (site D, Fig. 1) and Triangle X nest in Grand Teton National Park (site X, Fig. 1). However, adults associated with these nests were not observed adequately to detect atypical plumage or white talons.

Other adults.—Between 1985 and 1989, 13 additional breeding adult, one injured adult, and 15 migrant Bald Eagles were captured in the Snake River watershed of Greater Yellowstone. Plumage and talon coloration of captured breeding adults not associated with atypical nestlings were normal. In June 1986, an injured and malnourished adult female Bald Eagle was captured by hand on a levee of the Snake River (site G, Fig. 1) less than 3 km from the Butler Creek nest. The eagle exhibited three white talons and white feathers on the proximal leading edge of the patagium. The eagle was rehabilitated and released but subsequently not found associated with a nest site. During productivity surveys in June 1986, the adult female at the Moose nest (site F, Fig. 1) exhibited a distinct white patch on the breast, approximately 2×2 cm that was characteristic of atypical plumage in nestlings (e.g., Fig. 4). None of three nestlings produced at the Moose site between 1986 and 1989 possessed atypical plumage.

Golden Eagles.—Since being alerted to atypical plumage in Bald Eagles, similar plumage and talon coloration were recorded in Golden Eagles (*Aquila chrysaetos*) in Montana (Harmata, unpubl. data). Three of 126 captured Golden Eagles exhibited white epaulets similar to Imperial eagles (*Aquila heliaca*), but considerably smaller. One adult male Golden Eagle observed exhibited extensive white plumage on the anterior patagium of both wings and four of 35 nestling Golden Eagles banded exhibited white talons and/or epaulets.

DISCUSSION

Proportion of Bald Eagle nestlings banded within Greater Yellowstone between 1979 and 1989 with atypical plumage and talon coloration (3.5%) probably was not representative of actual incidence in the population overall. Only 43% to 67% of successful nests were entered during any particular year and nests entered were not randomly distributed. Proportion may have been greater, but more likely less, based on concentration of affected nestlings along the Snake River (Fig. 1) and absence of observations elsewhere in the region. The proportion of nestling Golden Eagles exhibiting atypical plumage and talon coloration (11%) suggests the condition may be more prevalent in Golden Eagles, at least in southwestern Montana.

Atypical plumage, cere, and talon coloration of Bald Eagles described herein was not inconsistent with partial albinism but was most similar to a genetically based, unbarred pied plumage described for domestic chickens (Punnett and Pease 1927). Pied is defined as "of two or more colors in blotches (as black and white)" (Cove *et al.* 1981). These characteristics in juvenile Bald Eagles were clearly atypical and may be partially or totally masked by successive immature and adult plumages. White crowns and chins would probably be masked in basic plumages (see McCollough 1989) when viewed at a distance and certainly masked in normal definitive plumage. All eaglets noted with pied plumage had white breast and/or abdominal down or contour feather patches, suggesting other pied characteristics were obvious in the Down-B phase (Stalmaster 1988) which is predominantly grey. Pied plumage in Golden Eagles would be obvious in all plumage classes.

Only two pied nestlings had white epaulets that would be evident in definitive plumage. If adults are not examined closely, white breast patches could easily be confused with molt or fouling and white epaulets confused with patagial tags. In fact, there were reports in the 1980s of adult Bald Eagles with white wing tags whose origin could not be identified. Two sightings were in Greater Yellowstone, two in Alberta, Canada, one in Glacier National Park, Montana (B. R. McClelland, *pers. comm.*), and one in western Montana (L. Rau, *pers. comm.*). At the time, no auxiliary marking authorizations permitted use of white patagial tags on Bald Eagles (D. Bystrak, *pers. comm.*). Unfamiliarity with pied plumage in Bald Eagles by both professional and lay observers may have led to confusion of pied plumage pattern with auxiliary markers.

Atypical pied plumage was expressed only in female Bald Eagles, suggesting a sex linked or sex influenced recessive gene (Chambers 1983, Welty 1982). Close genetic relationships among Bald Eagles exhibiting atypical characteristics are indicated by geographic concentration and proximity of nests with affected individuals. Nestling Bald Eagles exhibiting pied plumage all originated from the Snake River watershed, primarily in Wyoming. Band encounters and observations of color bands indicated recruitment in the Greater Yellowstone Bald Eagle population was primarily from eagles produced within the region and manifested at nest sites in close proximity to natal nests (Harmata and Oakleaf 1992). Such recruitment would promote more frequent, localized expression of the genetically based pied plumage. The absence of reports of atypical characteristics described here from other areas may indicate pied plumage and white talons in Bald Eagles are unique to Greater Yellowstone in general and the Snake River in particular.

ACKNOWLEDGMENTS

Bob Oakleaf and Robert P. Wood provided background, insight, and funding through Wyoming Game and Fish Dept. and National Park Service, Grand Teton National Park, respectively. Al Bath assisted in capture of pied adult Bald Eagles, banding of nestlings, and observed others. S. Cain, W. S. Clark, B. R. McClelland, M. Restani, E. Vyse, and an anony-

mous reviewer provided helpful comments on earlier drafts. E. Vyse identified the atypical plumage condition discussed as pied. S. Cain and M. Whitfield provided information on two pied eaglets.

In memory of Robert P. "Bob" Wood, a friend of the Tetons and a friend of ours.

LITERATURE CITED

- BENT, A. C. 1937. Life histories of North American birds of prey. Part I. U.S. Natl. Mus. Bull. 167.
- BORTOLOTTI, G. R. 1984. Criteria for determining age and sex of nestling Bald Eagles. *J. Field Ornithol.* 55:524-542.
- BROWN, L. H. AND D. AMADON. 1968. Eagles, hawks and falcons of the world. McGraw-Hill Book Co., New York. 945 pp.
- CHAMBERS, S. M. 1983. Genetic principals for managers. Pp. 15-46, *in* C. M. Schoenwald-Cox, S. M. Chambers, B. MacBryde, and L. Thomas, eds. Genetics and conservation. A reference for managing wild animal and plant populations. The Benjamin/Cummings Publishing Co., Inc., Menlo Park, California. 722 pp.
- CLARK, W. S. 1983. The field identification of North American eagles. *Amer. Birds* 37:822-826.
- , AND B. K. WHEELER. 1987. Hawks. Peterson field guides. Houghton Mifflin Co., Boston, Massachusetts. 198 pp.
- COVE, P. B., ED., AND THE MERRIAM-WEBSTER STAFF. 1981. Webster's third new international dictionary of the English language unabridged. Merriam-Webster, Inc., Springfield, Massachusetts. 2663 pp.
- GARCELON, D. K., M. S. MARTELL, P. T. REDIG, AND L. C. BUOEN. 1985. Morphometric, karyotypic, and laparoscopic techniques for determining sex in Bald Eagles. *J. Wildl. Manage.* 49:595-599.
- GERRARD, J. M., D. W. A. WHITFIELD, P. GERRARD, P. N. GERRARD, AND W. J. MAHER. 1978. Migratory movements and plumage of subadult Saskatchewan Bald Eagles. *Can. Field-Nat.* 92:375-382.
- GREATER YELLOWSTONE BALD EAGLE WORKING GROUP. 1996. Greater Yellowstone Bald Eagle management plan: 1995 update. Greater Yellowstone Bald Eagle Working Group. Wyoming Game & Fish Dept., Lander, Wyoming. 47 pp.
- HARMATA, A. R., AND B. OAKLEAF. 1992. Bald eagles in the Greater Yellowstone Ecosystem: an ecological study with emphasis on the Snake River, Wyoming. Wyoming Game & Fish Dept., Cheyenne. 2 vols. 368 pp.
- , AND D. W. STAHLCKER. 1993. Fidelity of migrant Bald Eagles to wintering grounds in southern Colorado and northern New Mexico. *J. Field Ornithol.* 64:129-134.
- , AND M. RESTANI. 1995. Environmental contaminants and cholinesterase in blood of vernal migrant Bald and Golden Eagles in Montana. *Intermountain J. Sci.* 1:1-15.
- HODGES, J. I., E. L. BOEKER, AND A. J. HANSEN. 1987. Movements of radio-tagged Bald Eagles, *Haliaeetus leucocephalus*, in and from southeastern Alaska. *Can. Field. Nat.* 101:136-140.
- MCCLELLAND, B. R., L. S. YOUNG, P. T. MCCLELLAND, J. G. CRENSHAW, H. L. ALLEN, AND D. S. SHEA. 1994. Migration ecology of Bald Eagles from autumn concentrations in Glacier National Park, Montana. *Wildl. Mono.* 125. 61 pp.
- MCCOLLOUGH, M. R. 1989. Molting sequence and aging of Bald Eagles. *Wilson Bull.* 101:1-10.
- PUNNETT, R. C., AND M. S. PEASE. 1927. Genetic studies in poultry. V. On a case of pied plumage. *J. Genetics.* 18:207-218.
- SOUTHERN, W. E. 1964. Additional observations on winter Bald Eagle populations: including remarks on biotelemetry techniques and immature plumages. *Wilson Bull.* 76:121-137.
- . 1967. Further comments on subadult Bald Eagle plumages. *Jack-Pine Warbler* 45: 70-80.
- STALMASTER, M. V. 1986. The Bald Eagle. Universe Books, New York. 227 pp.
- . 1988. Bald Eagle. Pp. 187-237, *in* R. S. Palmer, ed. Handbook of North American birds. Vol. 4. Diurnal raptors (Part 1). Yale University Press, New Haven Connecticut. 433 pp.

- WELTY, J. C. D. 1982. The life of birds. Third Edition. CBS College Publishing, W. B. Saunders Co. Philadelphia, Pennsylvania. 754 pp.
- WHEELER, B. K., AND W. S. CLARK. 1995. A photographic guide to North American raptors. Academic Press, San Diego, California. 198 pp.

Received 16 Apr. 1997; accepted 13 Oct. 1997.