

## LITERATURE CITED

- AR, A., C. V. PAGANELLI, R. B. REEVES, D. B. GREEN, AND H. RAHN. 1974. The avian egg: water vapor conductance, shell thickness, and functional pore area. *Condor* 76:153-158.
- AR, A., AND H. RAHN. 1978. Interdependence of gas conductance, incubation length, and weight of the avian egg, p. 227-236. In J. Piiper [ed.], *Respiratory function in birds, adult and embryonic*. Springer, New York.
- BIRCHARD, G. F., AND D. L. KILGORE, JR. 1980. Conductance of water vapor in eggs of burrowing and nonburrowing birds: implications for embryonic gas exchange. *Physiol. Zool.* 53:284-292.
- CAREY, C. 1979. Increase in conductance to water vapor during incubation in eggs of two avian species. *J. Exp. Zool.* 209:181-186.
- CAREY, C. 1983. Structure and function of avian eggs, p. 69-103. In R. F. Johnston [ed.], *Current ornithology*. Vol. 1. Plenum Press, New York.
- DRENT, R. H. 1970. Functional aspects of incubation in the Herring Gull. *Behaviour Suppl.* 17:1-132.
- HANKA, L. R., G. C. PACKARD, P. R. SOTHERLAND, T. L. TAIGEN, T. J. BOARDMAN, AND M. J. PACKARD. 1979. Ontogenetic changes in water-vapor conductance of eggs of Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*). *J. Exp. Zool.* 210:183-188.
- RAHN, H., R. A. ACKERMAN, AND C. V. PAGANELLI. 1977. Humidity in the avian nest and egg water loss during incubation. *Physiol. Zool.* 50:269-283.
- RAHN, H., AND A. AR. 1974. The avian egg: incubation time and water loss. *Condor* 76:147-152.
- SIMKISS, K. 1975. Calcium and avian reproduction. *Symp. Zool. Soc. Lond.* 35:307-337.
- SOTHERLAND, P. R., G. C. PACKARD, AND T. L. TAIGEN. 1979. Permeability of magpie and blackbird eggshells to water vapor: variation among and within nests of a single population. *Auk* 96:192-195.
- SOTHERLAND, P. R., G. C. PACKARD, T. L. TAIGEN, AND T. J. BOARDMAN. 1980. An altitudinal cline in conductance of Cliff Swallow (*Petrochelidon pyrrhonota*) eggs to water vapor. *Auk* 97:177-185.
- ZAR, J. H. 1974. *Biostatistical analysis*. Prentice-Hall, Englewood Cliffs, NJ.

*The Condor* 88:393-395  
© The Cooper Ornithological Society 1986

## REEVALUATION OF CHEEK PATTERNS OF JUVENAL-PLUMAGED BLUE-EYED AND KING SHAGS<sup>1</sup>

PAMELA C. RASMUSSEN

*Museum of Natural History and Department of Systematics and Ecology,  
University of Kansas, Lawrence, KS 66045*

*Key words:* Blue-eyed Shag; King Shag; juvenal plumages; *Phalacrocorax atriceps*; *Phalacrocorax albiventer*.

Blue-eyed (*Phalacrocorax atriceps*) and King shags (*P. albiventer*) occur allopatrically in certain subantarctic island groups and southern Argentina and Chile. The two species occur together in parts of extreme southern Argentina, Tierra del Fuego, and southern Chile. In adult *P. atriceps* (Fig. 1f) the cheek is white, the hindneck has only a narrow strip of black feathers, and there frequently is a white mid-dorsal patch. In adult *P. albiventer* (Fig. 1e) the cheek is glossy black, the hindneck is entirely black, and there is no white dorsal patch (Murphy 1936, Behn et al. 1955, Rand 1956, Humphrey et al. 1970, Devillers and Terschuren 1978). Unlike adult plumages, juvenal plumages of the two species are poorly known. During a study of the systematic relationships of *P. atriceps* and *P. albiventer*, I found that cheek patterns of juvenile *P. atriceps* resemble those of adult *P. albiventer* or apparent intermediates between the two species. This paper presents evidence concerning the identification of juvenile Blue-eyed and King shags and provides descriptions of juvenile head plumages of these species.

### METHODS

I examined 84 shag specimens in juvenal plumage or first prebasic molt for pattern and wear of cheek feathers and made a reference sketch of the cheek pattern of each specimen. Specimens examined were from Argentina ( $n = 38$ ), Chile ( $n = 14$ ), the Falkland Islands ( $n = 4$ ), Antarctica ( $n = 9$ ), the South Shetland Islands ( $n = 6$ ), South Georgia Island ( $n = 11$ ), and Macquarie Island ( $n = 2$ ). To determine the approximate amount of wear of juvenal cheek feathers, I measured lengths of four or five feathers on the black-white border at least 2 cm posterior to the throat pouch-feather edge of each of four juveniles in fresh plumage. I also measured four or five feathers in the same areas of each of four specimens determined by wear of juvenal remiges and rectrices to be approximately one year of age at collection. I measured only dark-tipped, obviously juvenal feathers in year-old birds, as molt had begun and some new feathers were present. To find whether the amount of wear thus approximated could account for visible lightening of the cheek area before the first prebasic molt, I measured the lengths of the dark tips on 15 randomly selected cheek feathers, located at least 2 cm posterior to the throat pouch-feather border of four juvenile specimens in fresh plumage.

### RESULTS

Specimens from localities of allopatry show that juvenile *P. atriceps* have dark-tipped cheek feathers and look superficially similar to adult *P. albiventer*. I found no white-checked juveniles in fresh plumage from areas in which

<sup>1</sup> Received 15 October 1985. Final acceptance 31 March 1986.

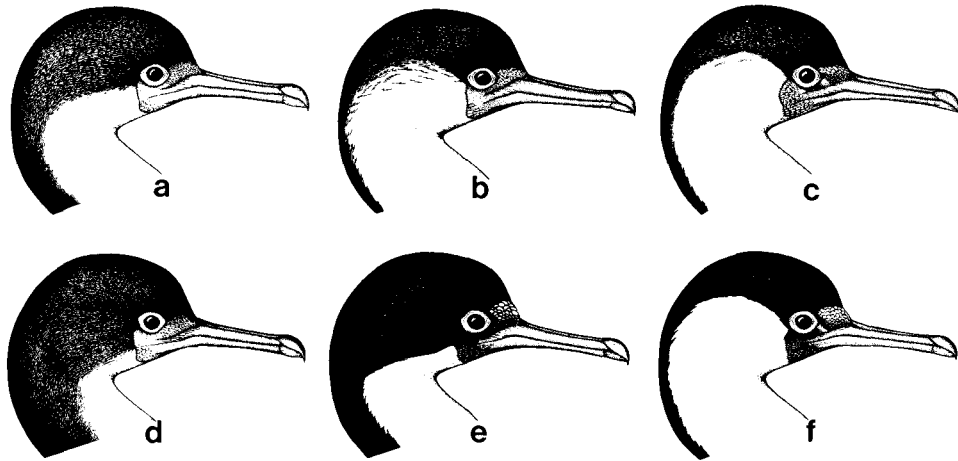


FIGURE 1. a—*Phalacrocorax atriceps* in fresh juvenal plumage; b—*P. atriceps* at several months of age; c—*P. atriceps* during first prebasic molt; d—*P. albiventer* in fresh juvenal plumage; e—*P. albiventer* adult; f—*P. atriceps* adult.

only *P. atriceps* is known to occur, and of 84 specimens examined, I found no specimens with both fresh juvenal feathers and white cheeks. Juvenile specimens from areas where only *P. atriceps* is known to occur, but which have dark-tipped cheek feathers, include a *P. a. atriceps* from Lago Nahuel Huapi, Neuquen, Argentina (MACN 5944a); one from Corral, Chile (NMNH 49142); two *P. a. georgianus* from South Georgia Island (NMNH nos. 571129 and 571132); and five *P. a. bransfieldensis* from Antarctica (NMNH nos. 370991, 368063, 370952, 370992, and 400940). The subterminal portions of the cheek feathers of these specimens are largely white, and only the tips are dark.

Specimens in juvenal plumage from localities at which only *P. albiventer* is known to occur showed more extensive dark feathering on the cheek than was found on juveniles from localities where only *P. atriceps* occurs. Dark feathering sometimes covers part of the sides of the chin and the ventral neck (Fig. 1d). In contrast to the mostly light, dark-tipped cheek feathers of the juvenal plumage in *P. atriceps*, the cheek feathers of *P. albiventer* in juvenal plumage are dark except for the bases. This was determined by examination of specimens from the following localities at which only *P. albiventer* is known to occur: Buenos Aires Province, Argentina (MACN 2303a, 2522a [3 specimens], 3379a, 8390c, 9135d); Golfo San Jose, Chubut Province, Argentina (MACN 52792); and the Falkland Islands (AMNH 730180, 730181).

Four *P. atriceps* specimens, determined to be approximately one year old by wear of juvenal flight feathers and by date of collection, show varying amounts of dark streaking in their otherwise white cheeks (MACN 49–43, 9014a; AMNH 349555, 442422). Most *P. atriceps* (17 of 21 examined) approximately one year of age did not have dark tips on the cheek feathers (Fig. 1c), and had a cheek pattern like that of adults. In contrast, seven *P. albiventer*, determined in the same way to be about one year old, had dark cheeks at collection, as do the adults of that species. For *P. atriceps*, mean length for unworn juvenal cheek feathers was 15.2 mm (SD = 1.03,  $n = 19$ ), longer than the mean feather length of year-old birds, 13.5 mm (SD = 1.26,  $n = 19$ ,  $t = 4.56$ ,  $P < 0.001$ ). Mean length of the dark tips of unworn feathers was 4.4 mm (SD = 1.94,  $n = 60$ ). Thus, although a significant amount of wear occurs, the dark tips of only some of the cheek feathers apparently wear off before the first prebasic molt, while wear of others exposes more white feather bases.

The following descriptions of head feathering are based

on 52 specimens of *P. atriceps* and 22 of *P. albiventer* in juvenal plumage.

#### DESCRIPTION

*P. atriceps*. Juvenal plumage acquired late austral summer and worn until austral spring and summer. Crown and hindneck black, sides of head and lores black grading into brownish black on the cheek (i.e., upper auriculars and surrounding feathers). Individual feathers have dark tips and shafts. Feathers above auriculars are more extensively black and have pale gray bases. Feather wear during the year exposes white bases of some cheek feathers, so birds several months old have streaked cheeks. Black feathers fade to brown by end of first year. Chin, throat, lower half of auriculars from line slightly above gape and ventral half of neck are white, sometimes with a few faint streaks.

*P. albiventer*. Juvenal plumage of head and neck as in *P. atriceps* except: auriculars black (including lower half which is white in *atriceps*); individual feathers with gray bases (instead of white as in *atriceps*); feathers ventral to auriculars dark with white bases; auriculars and cheek to line from gape to ventral margin of auriculars remain dark (as in adults) throughout the first year of life (in *atriceps* lower half of auriculars and all of cheek feathers wear to white with dark streaks during first year); chin and throat white; black on sides of neck extends ventrally, covering all but ventral third of neck (in *atriceps* black on sides of neck does not extend as far ventrally).

Juvenile *P. atriceps* differ from adult *P. albiventer* in having mottled pale brown rather than pure white alar bars, and slaty rather than glossy black feathers that fade to brownish before the first molt, and in lacking crests and caruncles (Watson 1975). *P. atriceps* in juvenal plumage also often have the cheek streaked, while adults lack streaking.

#### DISCUSSION

On 12 February 1985, at the mixed shag colony on Isla Chata, Santa Cruz Province, Argentina, I estimated 800 shags, of which 87% had the cheek pattern of *P. atriceps* and 13% that of *P. albiventer*. About 35 fledged juveniles were present, and all had mostly dark cheeks (Fig. 1a). I had expected at least some juveniles in a colony composed mostly of *P. atriceps* to have white cheeks, following Watson (1975) and Harrison (1983). At this island there was considerable variation among individuals in extent of dark feathering on the cheeks, and in light of the above data, juveniles of both species were probably present. Six ju-

venile specimens thought to be *P. albiventer* prior to collection were later determined, using the above criteria, to be *P. atriceps*.

Scott and Sharpe (1915) stated that immature *P. atriceps* are like immature *P. albiventer*, but that in juveniles of *P. albiventer* "the white area on the throat is narrow compared with *atriceps* in the same plumage . . ." A figure (in Scott and Sharpe 1915) labeled as an immature *P. albiventer* from Cabo Buen Tiempo actually shows a juvenile *P. atriceps*, but was interpreted by Devillers and Terschuren (1978) as an intermediate between *P. atriceps* and *P. albiventer*. Reynolds (1935), discussing *P. atriceps* at Grevy Island, Chile, stated that "Immature birds . . . with the black extending far down on the side of the face and less white on the neck, were equally plentiful with adults . . ." Murphy (1936) apparently assumed that Reynolds had misidentified adult *P. albiventer* as juvenile *P. atriceps*. Friedmann (1945), on geographical grounds, considered four juvenal-plumaged Blue-eyed Shags from Antarctica with mottled alar bars, slaty dorsal plumage, and juvenal flight feathers, (NMNH 370991, 368063, 370952, 370992) to be adult *P. atriceps bransfieldensis*. He was puzzled by the fact that "one has the dark head color extending postero-ventrally to include the auriculars and certainly would 'key out' to *albiventer* on that basis." Watson (1975), Devillers and Terschuren (1978), and Harrison (1983) stated that juvenal-plumaged *P. atriceps* are similar to adults in overall pattern.

The type of *P. atriceps* is an immature specimen; the original description of *P. atriceps* (King 1828) did not mention cheek pattern. I have not examined the type, but according to Devillers and Terschuren (1978), in cheek pattern it "is intermediate between '*albiventer*' and '*atriceps*', rather closer to the former. It does not represent what is currently known as 'typical *atriceps*'." The photograph of the type in their paper illustrates a specimen of *P. atriceps* in what appears to be typical worn juvenal plumage with lightly streaked cheek feathers (as in Fig. 1b).

In conclusion, juvenile *P. atriceps*, including the type specimen, have been confused with both young and adult *P. albiventer*, and misidentified as intermediates between *P. atriceps* and *P. albiventer*. Juveniles may be identified to species by their cheek patterns. Feather wear in juvenile *P. atriceps* causes some lightening of the cheek in the first year.

I thank P. S. Humphrey and D. Siegel-Causey for help and advice throughout this study. I thank the following for generous assistance: J. Vinuesa, Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET); E. I. Porter, Prefectura Naval Argentina, and Intendente R. G.

Wilson, Puerto Deseado; R. Clarke, Dpto. Conservación de la Fauna, Provincia de Santa Cruz. For access to collections and loan of specimens, G. F. Barrowclough, W. E. Lanyon, and M. LeCroy, American Museum of Natural History (AMNH); K. C. Parkes and J. Loughlin, Carnegie Museum of Natural History; S. M. Lanyon, Field Museum of Natural History; J. Navas, Museo Argentino de Ciencias Naturales (MACN); R. L. Zusi, National Museum of Natural History (NMNH); and C. Sibley and E. Stickney, Yale Peabody Museum. R. M. Mengel and M. D. Gottfried read and K. McManness typed the manuscript. Support was provided by a collections study grant and the Frank M. Chapman Memorial Fund, both of the American Museum of Natural History; the Museum of Natural History and the Department of Systematics and Ecology, the University of Kansas; and National Science Foundation Grant BSR-8407365 to Humphrey and Siegel-Causey.

#### LITERATURE CITED

- BEHN, F., J. D. GOODALL, A. W. JOHNSON, AND R. A. PHILIPPI. 1955. The geographic distribution of the Blue-eyed Shags, *Phalacrocorax albiventer* and *Phalacrocorax atriceps*. *Auk* 72:6-13.
- DEVILLERS, P., AND J. A. TERSCHUREN. 1978. Relationships between the Blue-eyed Shags of South America. *Gerfaut* 68:53-86.
- FRIEDMANN, H. 1945. Birds of the United States Antarctic Service expedition 1939-1941. *Proc. Am. Philos. Soc.* 89:305-313.
- HARRISON, P. 1983. *Seabirds: an identification guide*. Houghton Mifflin Co., Boston.
- HUMPHREY, P. S., D. BRIDGE, P. W. REYNOLDS, AND R. T. PETERSON. 1970. *Birds of Isla Grande (Tierra del Fuego)*. Smithsonian Institution, Washington, DC.
- KING, P. P. 1828. Extracts from a letter addressed by Capt. Philip Parker King, R.N., F.R.S., and L.S., to N. A. Vigors, Esq., on the animals of the Straits of Magellan (Part 2). *Zoological Journal* 4:91-105.
- MURPHY, R. C. 1936. *Oceanic birds of South America*. American Museum of Natural History, New York.
- RAND, R. W. 1956. Cormorants on Marion Island. *Ostrich* 98:127-133.
- REYNOLDS, P. W. 1935. Notes on the birds of Cape Horn. *Ibis* 13:65-101.
- SCOTT, W.E.D., AND R. B. SHARPE. 1915. *Reports of the Princeton University Expeditions to Patagonia 1896-1899*. Vol. 2. Ornithology. Princeton Univ. Princeton, NJ.
- WATSON, G. E. 1975. *Birds of the Antarctic and Sub-Antarctic*. American Geophysical Union, Washington, DC.