

TABLE 1. Characteristics of four adult gulls collected from North Marble Island, Glacier Bay National Monument, Alaska.

	Iris	Eye-ring	Legs and feet	Inside of mouth	Tips of primaries	Sex	Gonad size (mm)
Intermediates							
1	Mottled brownish yellow	Flesh	Pale flesh	Flesh	Gray, much darker than mantle	Male	20 × 10
2	Pale yellowish gray	Flesh	Flesh pale	Flesh	Gray, much darker than mantle	Male	24 × 13
3	Brownish gray-yellow	Pink	Pale flesh-gray	Flesh	Gray, much darker than mantle	Male	20 × 16
Herring	4 Clear yellow	Yellow	Pale flesh	Flesh	Black	Male	25 × 20
Glaucous-winged (typical)							
Herring (typical)	Yellow	Yellow	Pale flesh	Flesh	Black		

Colors adopted from R. Palmer, Handbook of North American birds, Vol. 1, 1962.

"typical" Glaucous-winged Gull; and 3 apparent "backcross" pairs ("intermediate" paired with Glaucous-winged Gull). The mixed, apparent backcross, and "pure" pairs successfully fledged young.

Permission was granted by Monument officials to collect only four adult gulls at the close of the nesting season. Three of the four gulls were intermediate with respect to primary pigmentation and eye color (table 1). The fourth bird collected was a Herring Gull. The amount of variation in primary feather pigmentation, in the iris color, and in the eye-ring color suggests the problem is more complicated than simple hybridization. Birds number 1, 2, and 4 were known to have been paired with Glaucous-winged Gulls.

N. G. Smith (A.O.U. Ornithol. Monogr. no. 4, 1966) suggests there are insufficient isolating mechanisms between the Herring and Glaucous-winged Gulls. Our field evidence confirms that this is the case for species recognition and nesting habitat selection in the Glacier Bay region. Further study is necessary to establish the extent of variation in primary pigmentation and iris and eye-ring color contrast in the Glaucous-winged Gull. Thereafter the extent of the sympatric zone in the Gulf of Alaska should be explored.

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## ECOLOGICAL STUDIES OF THE PLUMES OF THE PEACOCK (*PAVO CRISTATUS*)

INDRA KUMAR SHARMA

Bhagwati Bhavan  
Ratanda Road  
Jodhpur 20, India

Plumes of the Peacock (*Pavo cristatus*) have been popular since ancient times because they are charmingly colorful; they also have economic value. Some ornithologists have given general descriptions of Peacock, or Peafowl, plumes but they have not studied their general details and ecological aspects. Messurier (1904) states that the length of plumes varies from 100 to 120 cm, while Whistler (1949) states that the length is about 115 cm. Ali (1961) mentions that upper tail coverts measure about 120 cm. Baker (1930) states that upper tail coverts are smaller in size but with definite ocelli; that lower coverts are larger in size, shaped like a quarter-moon, without ocelli; and that outer coverts also lack ocelli. Dharamkumarsinghi (1956) mentions that plumes are molted in September. They begin to develop in the second year and attain full size in the fourth year.

## STUDY AREA

Observations were made at Jodhpur, which is situated at 26°N and 73°E, at an altitude of 243 m M.S.L. This is a semi-arid area, with large green patches of farms and gardens. Annual rainfall is 365 mm. Rains occur mainly during the monsoon (260 mm) in July and August. Maximum temperature in June is about 45°C and the minimum in January is 4°C.

## METHODS

Various typical habitats of the Peafowl were selected for the study in a radius of 15 km around Jodhpur. Observations were made during 1971 and 1972. To collect precise data on the rate of molt and development of plumes, individual Peacocks were kept in separate cages.

## TIMING OF MOLT

In the fourth week of August some Peacock plumes began to loosen and swing suspended. Because the loose plumes cause irritation, Peacocks removed them with their bills. They often preened their train of plumes, plucking out the loose ones. The rate of molt was very slow in the first week, i.e., three to six plumes per day. Molting increased in the second week to 6-21 feathers per day, and this continued through the fourth week. During the fifth and sixth

TABLE 1. Rate of molting in Peacocks.

Week of molt	Feathers molted per day	
	$\bar{x}$	Range
1	5	3-6
2	16	6-21
3	6	6-21
4	5	6-21
5	1-3	2-4

weeks, the rate slowed to two to four plumes per day. In the eighth week, the small plumes remaining were molted irregularly. Plumes were molted in the following order: first, large plumes with ocelli; then medium-sized plumes; later, plumes without ocelli; and finally, small plumes on the upper rump (see table 1).

Plumes developed and grew in size in February when some courtship dance and display began to occur. Plumes attained full size in April before the beginning of the rut and continued to grow until August, the height of the breeding season. Molt occurred at the end of the breeding season in September. This correlation between the onset of molt and the end of the breeding season has also been observed in many other birds, i.e., males lose brilliant-colored feathers or color after the breeding season.

The molt began about a week earlier in the green farm habitat than in the local, semi-arid habitat where the soil is cultivated only once a year during the rainy season. In the arid habitat having a scarcity of plant leaves and sprouts for food, molt began about 1 week to 10 days later than in the semi-arid habitat. Thus, there was a difference of about 2 weeks in the initiation of molt between Peacocks of farm and arid habitats.

The rate of molt was very slow in farm habitats, taking about 3 weeks or more for completion, whereas in arid habitats it took only 2 weeks.

In 1971 there were regular rains but in 1972 the rains were late and irregular. In 1972, therefore, breeding was delayed, and molting subsequently occurred 12 days late. This indicates that rains have an indirect effect on molt.

Young adults began to molt a week earlier than old adults; it was about 2 weeks later. In Peacocks older than 9 years, molting was very irregular and some plumes were observed swinging from their trains long after the end of the molting season.

#### FEATHER SIZE

Peacock plumes may be classified into four types:

*Large feathers without ocelli.* These range from 153 to 170 cm, with the majority measuring 158-164 cm. A Peacock has about 60 plumes without ocelli. The average size of the various parts of such plumes is: circumference of quarter-moon at the tip, 7 cm diameter; free barbs at top, 14 cm; barbs at after shaft, 46 cm; and inferior umbilicus, about 4 cm.

TABLE 3. Development of feathers in the Peacock.

Week of molt	Size (cm)		
	Feathers with ocellus	Blue ocellus of feather	Feathers without ocellus
1	1.5	0.0	1.5
2	4.0	0.0	4.0
4	5-9	0.0	18.0
8	24-35	1.0	42.0
16	55-65	1.8	70.0
24	111-131	2.0	131.0
34	125-132	2.0	155.0
51	135-145	2.2	165.0

*Large feathers with ocelli.* There are about 145 in a Peacock and they measure 25-150 cm, occasionally as much as 157 cm. The majority of plumes measure between 80 and 135 cm.

*Oblique feathers.* On both lateral sides of the feathered train, some oblique, sword-shaped plumes without ocelli form the periphery of the fan of plumes of a dancing Peacock. Among them, four measure about 20 cm and two measure 65 cm. Four large-sized, oblique plumes (having small oblique ocelli) that measure about 140 cm are also found in the Peacock.

*Small feathers.* There are about 50 small plumes in the Peacock that measure less than 50 cm. Among them, about 20 are of very small size with insignificant ocelli. These measure 8.5-17 cm (see table 2). In the present study these mini-plumes were neglected and sometimes destroyed in the field. These may be used for decorative purposes. It should be noted that in the feathered train, different plumes situated at junction areas as buffer plumes have intermediate shape and size.

The size of the plume was found to be related to habitat. The average size of large plumes with ocelli in semi-arid habitats was 148 cm. At farms near villages where Peacocks enjoy sufficient green food and supplementary grains, the average size of such plumes was 152 cm. Thus, an abundance of green food and grains significantly increases the size of the plumes.

Within a week after plumes were molted in September, new ones began to emerge from the horny sheath (stratus corneum) as tufts of hair, dirt-brown in color with green tips. In the first week plumes grew 1.5 cm, in the second week they grew 4 cm and their color became metallic green. In the fourth week plumes with ocelli grew 5-9 cm and plumes without ocelli grew more than 18 cm. Lower coverts developed more and at this stage ocelli began to develop. For other measurements to the 51st week, see table 3. Table 3 shows that the growth rate of plumes with ocelli accelerated after the fourth week and it is high until the 24th week. The growth rate then slowed until the plumes were molted. Plumes

TABLE 2. Measurements (cm) of small feathers of Peacocks.

Total feather length	Aftershaft	Barbs	Head	Ocellus brown	Ocellus green	Ocellus blue	Depth embedded
9.5	4.0	4.5	2.2	2.0	0.8	0.5	0.5
7.5	4.5	3.0	2.0	1.4	0.5	0.2	0.4
7.0	5.0	1.5	0.5	none	none	none	0.3

TABLE 4. Relation between sizes of feathers, their barbs, and ocelli.

Size of feathers (cm)	Size of aftershaft (cm)	Size of barbs (cm)	Size of head (cm)	Size of brown ocellus (cm)	Size of green ocellus (cm)	Size of blue ocellus (cm)	Feathers embedded (mm)
32	11	8	10	5.0	2.0	1.5	2.0
50	15	8	11	6.0	2.0	1.5	2.0
80	33	14	10	4.5	3.0	2.0	3.0
98	33	14	10	5.0	3.5	2.5	3.5
150	42	12	10	3.5	2.5	1.5	4.5

without ocelli showed faster growth from the fourth to eighth week than plumes with ocelli.

Table 4 shows that the size of the after shaft of plumes increased with plume size. Sizes of barbs were not proportional to plume size. Heads of plumes showed no remarkable difference in size with size of plumes, but instead the size decreased beyond a feather length of 50 cm. Brown ocelli are largest (6 cm wide) in smaller-sized plumes, i.e., 50 cm, and they decrease with plume length. Green and blue ocelli are largest (3.5 and 2.5 cm, respectively) in medium-sized (98 cm) plumes, then the sizes decrease with further plume length. Embedment of plumes is directly proportional to plume size.

#### COLLECTION AND EXPLOITATION OF FEATHERS

Because Peacock plumes have decorative, domestic, religious, and commercial value, they are collected on a large scale. Village boys collect molted plumes found scattered in fields, farms, on roofs of houses, etc. They sell these plumes to a retail buyer who visits the villages periodically. The buyer transports bundles of hundreds of feathers on donkeys and sells them to a wholesale dealer. The dealer sorts plumes according to sizes and prepares bundles of 200 each. Bundles of sorted plumes are sold to a large-scale wholesale dealer who sells them to wholesale buyers in various states of India. A large quantity of plumes is exported.

Plume quality could be increased by providing supplementary cheap grain to local Peafowls; this would increase growth of plumes and, through rapid

satiation and a consequent decrease in strife, decrease plume wear. Plumes may be collected regularly at rest sites without damage by exposure to dust, rain, and animals. Since a large number of plumes are usually destroyed by rats and woolen cloth moths, i.e., *Trichophaga*, *Tineola*, and *Tinea* sp., etc., plumes should be stored carefully to avoid pests. They should be sorted carefully so that all sizes can be utilized in the best way possible. Otherwise, a large number (particularly small ones less than 50 cm) are neglected and destroyed. Methods of safe transportation should be initiated so that no damage occurs during transport.

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#### THE FOOD OF NESTING DOUBLE-CRESTED AND PELAGIC CORMORANTS AT MANDARTE ISLAND, BRITISH COLUMBIA, WITH NOTES ON FEEDING ECOLOGY

IAN ROBERTSON<sup>1</sup>

Department of Zoology  
University of British Columbia  
Vancouver, British Columbia  
Canada

The widespread view that cormorants are a menace to fisheries deserves continuing reappraisal. This is particularly relevant to the Double-crested Cormorant (*Phalacrocorax auritus*) against which control measures have been considered (McLeod and Bondar 1953), and in at least one case actively carried out

(Gross 1950). A curious feature of such policies is that they have been considered and carried out in spite of mounting evidence that Double-crested Cormorants, either in marine or fresh-water habitats, seldom take commercially valuable fish (Lewis 1929; Mendall 1936; Scattergood 1950; McLeod and Bondar 1953; Palmer 1962). Although predatory animals are now objects of increased sympathy, the original question of whether cormorants, and fish-eating birds in general, are a threat to fisheries remains worthy of scientific inquiry. Since little is known of the diet of cormorants inhabiting the Pacific Coast of North America, this brief paper partially fills the gap.

During the course of a 3-year study (1969-71) on the brood-rearing capabilities of Double-crested Cormorants and Pelagic Cormorants (*P. pelagicus*), there were frequent opportunities to gather information on food habits. Cormorant chicks which were disturbed during weighing or banding activities frequently regurgitated their stomach contents. These regurgitations were collected and later identified and

<sup>1</sup> Present address: Environmental Protection Service, 100 Park Royal Avenue, West Vancouver, British Columbia, V7T 1A2 Canada.