Plumages and primary moult in Lesser Flamingos

L. SILEO, C. H. TUITE, and J. B. D. HOPCRAFT

Introduction

There is at present little published information on the growth, plumage development and moult of the Lesser Flamingo *Phoeniconaias minor*. The adult plumage and several gradations of post-fledging juvenile or sub-adult feathering are easily distinguishable. However, the age at maturity and the life span are unknown and there are no data on the correlation of plumages and age for ringed or captive Lesser Flamingos of known age. Brown (1960, 1973) suggests several years are required to reach sexual maturity and that the species is long-lived. Several ornithological texts state that flamingos like divers, grebes and waterfowl, undergo a complete simultaneous primary moult leaving them flightless (Palmer 1962; Allen 1956). These statements are possibly based on observation of *Phoenicopterus* sp. Indirect evidence of a complete simultaneous primary moult in the Lesser Flamingo is reported by Brown & Root (1971) from several observations of the inability of birds in nesting colonies to take flight when disturbed by a low flying aircraft. However, no primary moult data from observation of birds in the hand has been reported for this species.

Materials and methods

Between March 1974 and September 1976, during the course of disease and ecological investigations of Lesser Flamingos in Kenya, the primary flight feathers of 108 individuals were examined. During April 1974 and September 1976, sick flamingos were captured at Lake Nakuru by chasing on foot. The birds were transported to the Veterinary Investigation Laboratory at Nakuru, where they were weighed, examined, killed and post-mortemed. Colour of iris, bill, legs, contour feathers, wing coverts and axillars and presence of the thymus and bursa of Fabricius were recorded. Two separate ageing methods were defined, each with three age classes; one according to external colouration and another according to bursal and thymal characteristics. Both wings were removed from 47 individuals and air dried for later examination. Primaries were numbered from 1 to 11, proximal to distal. The number and length of each growing primary was recorded. We assumed that a primary much darker and less frayed than the adjacent primaries was a younger or newer feather. Each primary feather was assessed as 'new' or 'old', based on colour and wear, or as 'growing', when there were empty follicles or immature feathers. New and old were assumed to represent different feather generations as defined by Palmer (1972) after Humphrey & Parkes (1959). Between April 1975 and January 1976, samples of birds were trapped by netting at Lakes Nakuru and Bogoria (Formerly Hannington). Measurements of leg/wing length and weight were made and moult and external plumage characters were recorded as above. These birds were then released.

Age classes based on bursal and thymal condition were: (I) both thymus and bursa present; (II) bursa only present; (III) both absent.

Results

Age classes based on external colouration are summarized in Table 1. There was an apparent increase in the intensity of red colouration of the plumage of older

Table 1. Age classes of 47 Lesser Flamingos based on colouration.

Age Class	Iris	Bill	Legs	Wing coverts	Head/ neck	Back
I.	brown	grey	grey	grey/ white	grey	grey/ white
II.	brown/ orange	light red	grey/ pink	white/ pink	white/ pink	white/ pink
III.	orange	dark red	pink	red	pink	pink

Table 2. Comparison of age classes based on thymus and bursal condition with age classes based on colouration.

Age Class	Thymus	Bursa	Age class according to colouration I.	II.	III.	Total
I.	present	present	1	3	1	5
II.	absent	present	9	4	4	17
III.	absent	absent	0	7	18	25
Total			10	14	23	47

flamingos. In both systems age classes I and II were thought to represent juvenile or sub-adult stages whereas III was assumed to be adult. The two ageing methods are compared in Table 2.

Wings from 4 of the 47 sick flamingos examined in 1974 had one or more immature growing feathers from 2 to 86 mm long, and 19 of them had one or more mature feathers much darker and less worn than the other feathers on the wing (Figures 1 and 2). These observations suggested a partial primary moult. This partial moult did not appear to have a regular sequence. In nine individuals, where replacement of only one feather per wing had taken place, the new feather was in positions 1, 4, 7 or 8. Some birds had more than one new feather per wing. In one flamingo replacement of 1 to 5 in the left wing and 1 to 6 in the right wing had occurred. In another, primaries 1, 3 and 8 were new in both wings. In 14 flamingos different sequences occurred on opposite wings.

The samples of birds trapped by netting contained twenty-seven, in which various combinations of old and fully grown new primaries were present; twenty with new, old and one or more growing primaries; six with full wings of fully grown new primaries and three with complete wings of old primaries. In forty-seven of these birds, in which there was evidence of moult in progress or arrested moult, the replacement patterns in the two wings were either out of phase or different.

Of the five flamingos captured in September 1976, four had empty follicles or one or more immature growing primaries. In one of these individuals all eleven primaries on the right wing were immature and on the left wing there eleven worn mature feathers (Figure 3).

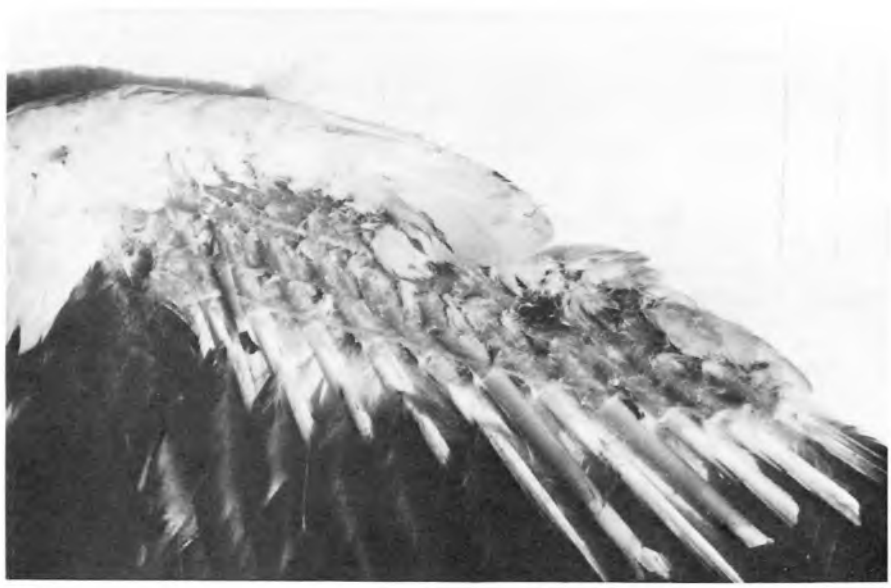

Figure 1. Ventral view left wing. Primaries No. 6 and 8 are immature.

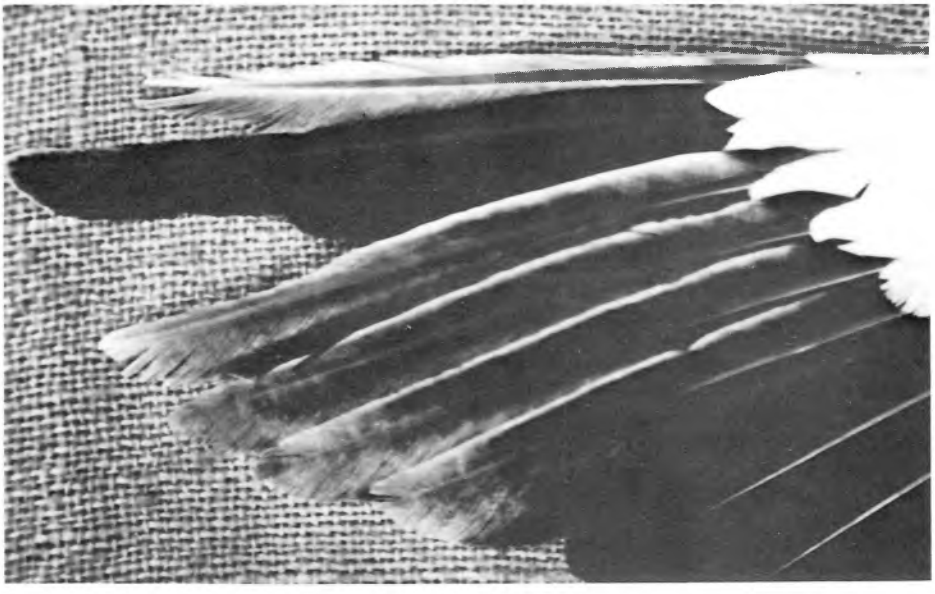

Figure 2. Dorsal view left wing. Primaries No. 6, 7, 8, 9, and 11 are faded, grazed and worn. Primary No. 10 is less worn, i.e. "new".

Discussion

It was clear from the post-mortems that the youngest birds examined had a thymus, bursa, and brown and grey plumage colouration and that the oldest birds lacked thymus and bursa, and had orange and red colouration. Between these extremes there was poor correlation of the two ageing methods. Until data on the ontogeny of these characters and the effects of environmental factors, especially nutrition, is available, neither colouration nor organ condition can be reliably used for determining the age of these birds.

Figure 3. Dorsal view right wing. All eleven primaries are immature.

Our data and earlier reports by Brown, and Brown and Root, suggest that Lesser Flamingos are capable of moulting their primaries either by a complete simultaneous moult or by a partial moult.

Amadon (1966) suggested that an optimum moult strategy might be one in which each feather is replaced as it becomes worn. Moreau *et al.* (1947) presented evidence of a variable moult pattern in *Colius striatus mombassicus*. However in many tropical species, moult strategy is altered by selective forces associated with the breeding, migration and food availability, e.g. Ashmole (1962, 1968). It seems reasonable to suggest that the irregular moult cycle of the Lesser Flamingo is an adaptation to the unpredictability of the tropical environment, in which these birds live. Lesser Flamingos lack a fixed annual breeding period (Brown & Root 1971) and do not nest every year. Also food availability is liable to large and rapid unpredictable changes. Flight feathers wear out continuously and require replacement. Pennycuick & Bartholomew (1973) predict that food availability is a critical factor in determining whether Lesser Flamingo breeding

can take place. It is therefore probable that the food supply for a breeding colony is abundant. This factor combined with the remoteness and inaccessability of flamingo breeding colonies in East Africa may allow a complete moult to flightlessness to take place without undue risk of starvation and/or predation. During years when conditions do not become suitable for breeding, flight feather replacement can take place by a partial moult. This leaves the birds with the ability to fly and to escape predation and sudden unexpected changes in food availability. Additionally when feeding conditions are sub-optimal the energy consumption for feather replacement is spread over a longer time. Future investigations will no doubt reveal a nexus of environmental, physiological and behavioural factors controlling this moult system.

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Summary

The relative ages of 47 Lesser Flamingos *Phoeniconaias minor* captured at Lake Nakuru, Kenya, were assessed by two methods: firstly by external colouration and secondly by bursal condition and thymal atrophy. It appeared that one or both of these parameters is not correlated with chronological age. Examination of the primary moult of a total of 108 birds showed that under some circumstances this species undergoes a partial sequential primary moult rather than the complete simultaneous moult reported previously. It is suggested that such a dual moulting pattern is an adaptation to life in a relatively unpredictable unseasonal tropical environment.

References

Allen, R. P. 1956. The flamingoes—their life history and survival. *Nat. Audubon Soc. Res. Rep.* No. 5. New York.

Amadon, D. 1966. Avian plumage and moults. *Condor* 68: 263–78.

Ashmole, N. P. 1962. The Black Noddy *Anous tenuirostris* on Ascension Island. Part I. General biology. *Ibis* 103b: 235–73.

Ashmole, N. P. 1968. Breeding and moult in the White Tern (*Gygis alba*) on Christmas Island, Pacific Ocean. *Condor* 70: 35–55.

Brown, L. H. 1960. *The mystery of the flamingoes*. London: Country Life.

Brown, L. H. 1973. *The mystery of the flamingoes*. 2nd ed. *Nairobi*: East African Publishing House.

Brown, L. H. & Root, A. 1971. The breeding behaviour of the Lesser Flamingo (*Phoeniconaias minor*). *Ibis* 113: 147–72.

Humphrey, P. S. & Parkes, K. C. 1959. An approach to the study of molts and plumages. *Auk* 76: 1–31.

Moreau, R. E., Wilks, A. L. & Rowan, W. 1947. The moult and gonadal cycles of 3 species of birds at five degrees south of the equator. Proc. Zool. Soc. Lond. 117: 345–64.

Palmer, R. S. 1962. *Handbook of North American birds,* Vol. 1. New Haven and London: Yale Univ. Press.

Palmer, R. S. 1972. Patterns of moulting. Pp. 65–102 in *Avian Biology*, Vol. 2. Ed. Farner, D. S. and King, J. R. New York and London: Academic Press.

Pennycuick, C. J. & Bartholomew, G. A. 1973. Energy budget of the Lesser Flamingo (*Phoeniconaias minor*). *E. Afr. Wildl. J.* 11: 199–207.

L. Sileo, International Development Research Centre, Wildlife Disease Project, Veterinary Research Laboratory, Kabete, Kenya.

C. H. Tuite, Dept. of Zoology, University of Bristol, Woodland Rood, Bristol, BS8 1UG, U.K.

J. B. D. Hopcraft, P.O. Box 33, Nakuru, Kenya.