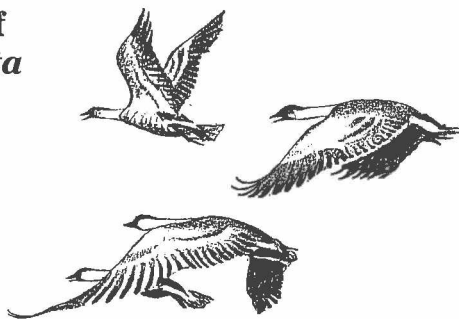


# A key to ageing goslings of the Hawaiian Goose *Branta sandvicensis*

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*The pattern of feather emergence in the goslings of captive Hawaiian Geese, or Nene, was photographed and scored visually to provide a guide for ageing goslings in the wild. The mean age at fledging was 68 days (range 58–77) and the mean age at which the juveniles took on an adult appearance was 137 days (range 119–150). The ability to determine the age of Nene goslings will enable field researchers to keep track of wild broods, thus allowing reliable assessments of recruitment, mortality and population size.*

**Keywords:** *Hawaiian Goose, Nene, Gosling Development, Growth, Plumage Colour, Ageing*

The Hawaiian Goose or Nene *Branta sandvicensis* is listed as endangered (B1+2bde;C2a), after application of the latest IUCN criteria (Version 2.3) for threatened taxa (Green 1995), and is the rarest goose in the world. Endemic to the Hawaiian Islands, its closest relative is thought to be the Canada Goose *B. canadensis* (Kear & Berger 1980). The Nene has been the subject of a 55-year recovery programme by the Hawaiian authorities in conjunction with The Wildfowl & Wetlands Trust (WWT), UK. Since the 1960s, over 2,000 captive-bred Nene have been released with the aim of restocking the diminishing wild population. Despite these efforts, Nene remain threatened and depend on continuous low level releases to sustain numbers. In 1990, a new five-year recovery initiative included scientific research aimed at determining the factors limiting the survival and productivity of Nene in the wild (Black 1990). In order to do this, researchers must be able to estimate accurately population size, recruitment and mortality rates. It has been observed that the majority of gosling deaths occur when they are very young (Banko 1988). Only older goslings, therefore, should be included in population estimates (J.M. Black, pers. comm.). Prior to the current study, there was no formal method of

determining the ages of Nene goslings for which hatching dates were unknown. Being able to estimate the ages of goslings also allows researchers to keep track of the very youngest surviving goslings and to determine the hatching dates of clutches from unknown nests. Results from this study provided the key for ageing goslings which was presented in the official Guide to the State-wide Database on Hawaiian Geese (Hunter & Black 1994).

A key to ageing Canada Goose goslings, comprising eight stages of feathering and development from hatching to fledging, was described by Yocom & Harris (1966), and has been adapted successfully for the Barnacle Goose *B. leucopsis* (Owen 1987). The aim of this study was to provide a similar key for determining the age of wild Nene goslings, which could be used easily and reliably without the need to handle birds.

## Methods

The Nene goslings studied were all parent-reared and ranged freely within the grounds of WWT, Slimbridge. Goslings, which were web-tagged, remained with their parents which were identified by

plastic (darvic) leg rings, and thus family groups could readily be identified. Hatching dates of all the goslings studied were known, although the sex of individual goslings was undetermined.

The pattern of feather emergence in 17 Nene goslings (11 broods) was recorded once a week for 11 weeks (April to July 1994) and given a developmental stage score of one to eight according to the Yocom & Harris (1966) scale for ageing Canada Goose goslings. The numbers of goslings observed at each stage are given in **Table 1**. The mean age at which the Nene goslings reached each of the eight stages of the Canada Goose scale was calculated. Photographs of goslings from different broods in each age class (e.g. 0–1 week old, 1–3 weeks) were taken for later comparison and as reference material for the final key. At the outset of the study, the ages of the goslings ranged from newly hatched to five weeks old, making it possible to obtain data for the whole development period. As the birds were pinioned and could not fly, "fledging" was determined as the point at which flight is possible in adults which is when the primaries are about 85% of their final length. At this point, in most goose species, the tips of the growing primaries reach the tail covert/tail feather junction (Owen 1980).

After fledging, the goslings continued to be monitored to determine the point at which the second moult to adult plumage occurred. The development of adult plumage was assumed to have occurred when the characteristic ring of black feathers, 0.5–1.0 cm wide, appeared at the base of the neck, between the buff colour of the neck, which also develops at this point, and the grey of the chest. The age at which the three oldest broods developed the neck-ring was recorded.

## Results

The pattern of feathering in the majority of the goslings was similar to that recorded for Canada Geese. As sex was not established, differences in development between sexes could not be assessed, although there was no noticeable variation in development within broods.

The mean ages at which the Nene goslings reached each of the eight stages of the Canada Goose scale are presented in **Table 1**. Differences in plumage development between goslings of the same age class (e.g. 0–1, 1–2 weeks) varied by an average of one developmental stage, with a maximum variation of one and a half stages, suggesting that the Canada Goose scale can be adapted for ageing Nene goslings with some degree of reliability.

The mean age at fledging was 68 days (9–10 weeks,  $n=6$  broods, range: 58–77 days).

The mean age at which the goslings were similar in appearance to adults, i.e. when the black ring of feathers at the base of the neck appeared, was 137 days (19–20 weeks,  $n=3$  broods, range: 119–150 days).

From the rather dull grey appearance of juveniles at fledging until the emergence of the neck-ring and other adult characteristics, the age of juveniles can be estimated at somewhere between nine and sixteen weeks. From twenty one weeks, there is no obvious difference between adults and juveniles in the field, although juveniles retain their wing and tail feathers for another 12 months or so (Kear & Berger 1980; J. Kear pers. comm.).





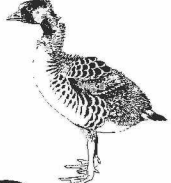
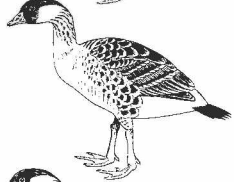
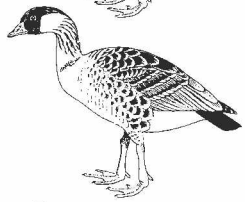
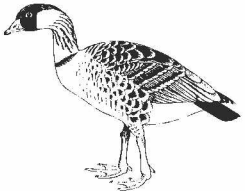
**Table 1. Ages at which Slimbridge Nene goslings reached each stage of the Canada Goose moult scale developed by Yocom & Harris (1966).**

Stage	Mean Age (days)	Range (weeks)	<i>n</i>	Standard error
1	4.5	0–1	2	0.50
2	22.9	2–4	8	2.07
3	32.1	4–6	8	1.60
4	42.2	5–7	8	1.63
5	51.0	6–8	12	1.84
6	59.5	7–9	6	2.62
7	64.0	8–9	10	1.93
8	73.2	10–11	4	1.65

## Discussion

Nene in Hawaii are thought to fledge at 10–12 weeks old, two to three weeks later than Slimbridge Nene (Kear & Berger 1980). Using this figure, the adapted Canada Goose scale shown in **Table 1** can now be corrected for wild Nene goslings and a key drawn from

Figure 1. Key for ageing Nene goslings in the wild

	Stage	Age (weeks)		
		Slimbridge	Hawaii	
	1	0-1	0-1	Small, round and downy, short legs. Breast and belly held almost parallel with ground.
	2	1-3	1-4	Downy. No contour feathering. Upright posture: breast and belly held at about 45° to ground.
	3	3-5	4-6	Downy. Beginning to feather on belly and wing coverts.
	4	5-7	6-8	Feathering on belly, flanks and wing coverts. Tail feathers just showing. Beginning to darken on face between eye and chin.
	5	7-8	8-10	Well feathered on belly, flanks and wing coverts. Tail 2.5 - 5.0 cm long. Head and neck darkening and losing down. Some down on back of neck and rump.
	6	8-11	10-12	Pre-fledging. Appearance of grey adult. Little or no down. Dark head and cheek becoming defined. Primary feathers almost reaching base of tail.
	7	9-16	11-18	Fledged. Primaries at full length. Well defined dark head and cheek. Neck dull grey.
	8	17-20+	19-23+	Looks almost identical to adult. Neck turning buff/gold, distinctive black ring forming between buff of neck and grey of chest.

the photographs of the goslings at different stages of development (**Figure 1**). The resultant scale is similar to that of Yocom & Harris (1966), differing only in that stages 5 and 6 are replaced by one intermediate stage for the Nene, and a stage representing the change from juvenile to adult plumage has been added.

The key can be used to estimate the ages of Nene goslings in the wild, although it should be stressed that a number of factors, including weather, day length, diet, amount of exercise, par-

asites and parental dominance, may cause variation in the rate of development between broods and individuals (Owen 1980; Kear in: Hosking 1985).

Both captive and wild Nene appear to mature faster than other goose species. By five months of age, they had acquired their adult plumage whereas other goose species do not moult to adult plumage until their first winter when they are nine or ten months old (Baker 1993). Wild Nene have bred successfully at the age of 11 months at Volcanoes National Park, Hawaii (Black *et al.* 1994).

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