

Evaluation of the Eye Lens Method for Age Determination in Sika Deer ¹

George A. FELDHAMER & Joseph A. CHAPMAN

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A significant curvilinear correlation between lens weight and age was obtained for 100 sika deer (*Cervus nippon* Temminck, 1836). The range of lens weights for each age class was distinctive for calves and yearlings only. Although age estimation by eruption and wear of dentition is currently more feasible, the eye-lens method may eventually be used to assign sika deer to more precise age categories.

[Appalachian Environmental Lab., Center for Environmental and Estuarine Studies, University of Maryland, Frostburg State College Campus, Gunter Hall, Frostburg, Maryland 21532, USA].

1. INTRODUCTION

Since the initial use of the eye lens technique to estimate age of *Sylvilagus floridanus* (Lord, 1959), the method has been evaluated for a variety of mammalian species (Friend, 1968). Here we report its feasibility to estimate the age of sika deer (*Cervus nippon*). This species is native to Japan and east-Asia and has been introduced into numerous regions, including the United States, the British Isles, continental Europe, and New Zealand (Feldhamer, in press). Within many areas of their introduced range, sika deer populations have become sufficiently established to be managed as game animals or pests.

2. METHODS

Lenses were collected from sika deer at deer check-stations from 25 November through 2 December 1978, in Dorchester County, Maryland. Samples also were obtained during this period from hunting camps in the area. The dressed weight of animals brought to check-stations was determined; sex was recorded for all deer and either the skull or a mandible was collected. All lenses were obtained within 12 hours of death. Eyeballs were removed intact and placed in 100 ml

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of 10 percent buffered formalin for 9 to 16 days. Lenses were not washed following removal from the eyeball. Lenses were oven-dried in glass dishes for 7 days at 37°C. They were removed and cooled in a desiccator for 1 hour, and weighed to the nearest 0.1 mg on a Mettler H35AR balance.

Because known-age sika deer were not available as a standard, comparative age of deer was based on the eruption and wear patterns of mandibular dentition. For consistency, one of us (G. A. F.) made all the age estimations. Age classes were determined according to criteria established by Duff (1969) for sika deer and by Lowe (1967) for red deer (*Cervus elaphus*). Because they are taxonomically similar and frequently hybridize (Lowe & Gardiner, 1975), the criteria established for red deer are believed to be applicable to sika deer (Kiddie, 1962; Lowe, 1977 and personal communication). The age class categories established by Lowe (1967) are retained here for consistency. Because parturition in sika deer in Maryland predominately occurs from May through June, and all animals were collected during a 1 week period, the age classes closely correspond to the following absolute ages: age class 0=6—7 mo. (calves); age class 1=18—19 mo. (yearlings); age class 2=30—31 mo. (adults); and so forth.

Data were analyzed on a Univac 1004 computer using programs from the Statistical Package for Social Sciences (SPSS).

3. RESULTS AND DISCUSSION

Eye lenses were collected from 51 males and 49 females, ranging in age from calves to age class 9. The majority of animals (70 percent) were calves or yearlings. The mean difference in weight between left and right lenses from each animal was 2.4 percent for males and females. However, because this difference ranged up to 8.9 percent between pairs of apparently undamaged lenses, all analyses were conducted using the heavier of the two lenses.

Both linear and curvilinear least squares regression models were fitted to the data, with lens weight as the dependent variable. The best predictive model was obtained with $\hat{y} = a + b \log_{10} X$. The actual form of the independent variable X was (age class + 1), to eliminate computing $\log_{10} 0$ for calves. The relationship between lens weight and age was computed independently for males and females. The data from age class 0 were used in both male and female analyses because sex could not be determined for calves, either on the basis of pedical development or other cranial characteristics. There was no significant difference between lens weight and age for males and females of the same age class ($F=0.125$; $P < 0.99$). Therefore, the data were combined and the relationship of lens weight to age derived was $\hat{y} = 266.46 + 390.38 \log_{10} (X+1)$, $r^2=0.95$; $P < 0.001$ (Fig. 1). Longhurst (1964) also found the model $\hat{y} = a + b \log_{10} X$ best represented the relationship between eye lens weight and age of black-tailed deer (*Odocoileus hemionus columbianus*), although a significant difference existed between sexes.

It is apparent that the greatest difference in lens weights of sika deer occurred between calves and yearlings. No overlap in ranges of lens weights existed between these age classes; mean lens weight increased 30.6 percent from calves to yearlings. Overlap did occur between yearlings and age class 2, and between most other adult age classes. Lenses of sika deer apparently continued to increase in weight through age class 9. Maringgele (1979) found a threefold increase in eye lens weight of roe deer (*Capreolus capreolus*) between 1 month and 2—3 years of age. Eye lens weights continued to increase through

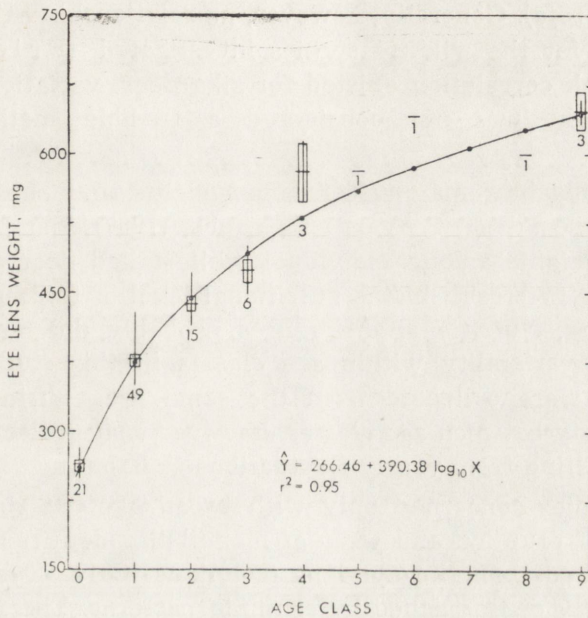


Fig. 1. Relationship of lens weight and age in sika deer.

Males and females combined. Dots represent predicted values from fitted curve; horizontal lines represent observed means; rectangles represent 95 percent confidence intervals and vertical lines represent observed ranges.

ten years of age in this species. An eye lens weight-to-age curve established for red deer (Maringgele, 1979) is similar to that for sika deer. However, his sample size (19) was insufficient to demonstrate significant differences between age classes. In most of the studies summarized by Friend (1968) on white-tailed deer (*Odocoileus virginianus*), overlap between age classes limited the usefulness of the lens weight technique.

A relatively weak correlation existed between lens weight (dependent variable) and body weight for both sexes. Calves were excluded from

this analysis because sex could not be determined. For males this relationship was represented by $\hat{y}=192.18+3.95 X$ ($r^2=0.55$; $P < 0.001$), and for females by $\hat{y}=137.88+6.21 X$ ($r^2=0.46$; $P < 0.001$). For the same body weight, females had a significantly greater corresponding lens weight than males ($F=15.60$; $P < 0.001$). This was because of the sexual dimorphism evident in sika deer; like most cervids, males are larger than females (Bromely, 1956; Kiddie, 1962). Thus females that weighed the same as males were older, and their eye lenses were correspondingly heavier. Matschke (1963) also found a direct relationship between lens weight and body weight for the European wild hog (*Sus scrofa*). Generally, however, no relationship exists between these variables for the wildlife species investigated (Friend, 1968). Although a weak correlation existed for sika deer, variation was large and body weight was not considered a feasible method of age determination.

Nutritional variables may affect lens weights and subsequent age estimation. Friend & Severinghaus (1967) found that variability of lens weights among individual white-tailed deer of the same age classes were the result of the nutritional level of fetuses and young prior to weaning. Nutritional differences probably did not contribute significantly to variability within age classes in this study, however, as all animals were collected from the same area during a 1-week period. Variability between age classes, however, may reflect nutritional differences resulting from yearly fluctuations in habitat.

For field studies concerned only with broad age categories of sika deer, analysis of eruption and wear of mandibular dentition is a faster and easier method than the eye-lens technique. Calves, yearlings and adults are readily distinguished by eruption patterns. The formation of annuli in the cementum of incisors, although not a field technique, also may be used to determine yearly age classes of sika deer (Klevezal & Kleinenberg, 1967; Prisjahnjuk, 1968). Both these techniques have the benefit that large sample sizes are not needed to define age categories. However, the relationship between eye lens weight and age in sika deer may hold promise for developing more specific, narrowly differentiated age categories. This would depend upon the availability of known-age individuals. Currently, however, the eye lens technique appears to be limited in its application towards this species.

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George A. FELDHAMER i Joseph A. CHAPMAN

SOCZEWKI JAKO WSKAŹNIK WIEKU U JELENIA SIKA

Streszczenie

Zbadano 100 jeleni sika (*Cervus nippon* Temminck, 1836). Uzyskano istotną krzywoliniową korelację między ciężarem ich soczewek a wiekiem. Roczniaki mają ciężar soczewek większy o 30,6% od cieląt. Soczewka zwiększa ciężar w kolejnych klasach wiekowych, choć zakresy ekstremalne mogą zachodzić na siebie (Ryc. 1). Chociaż ocena wieku na podstawie wyrzynania się i ścierania uzębienia jest częściej stosowana, metoda ciężaru soczewek może być użyta do wyznaczenia bardziej precyzyjnych kategorii wiekowych u tego gatunku kopytnych.