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A MODEL FOR PREDICTING AGE-SPECIFIC BODY WEIGHTS OF NUTRIA WITHOUT AGE DETERMINATION*

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SUMMARY

A model proposed by Dixon *et al.* (1979) for predicting body weights of nutria is tested against a separate set of data on body weights of nutria aged by standard methods. Separate models are tested for males and females with regressions showing no significant differences between observed and predicted body weights. A slight decrease was observed in female body weights at ages greater than 2 years but the sample size was small for these ages.

INTRODUCTION

In an earlier paper (Dixon *et al.* 1979), a model was presented to predict weight gain patterns of nutria (*Myocastor coypus* Molina). The method is fast, non-destructive and does not require age determination. The purpose of this paper is to present data on age-specific body weights of nutria and to test the validity of the model for predicting body weights.

Several methods of determining the pattern of weight gain of a species in a given locality are possible: (1) individual animals kept in captivity can be weighed at successive times, (2) marked animals can be recaptured several times throughout their lifespan and weighed at each capture, (3) individual animals can be captured, weighed and aged at the same time. Each of these methods has both advantages and disadvantages. Method 1 has the advantage that data are relatively easy to collect on penned animals; however, food and environmental factors may not be representative of natural conditions. Method 2 will provide an accurate weight gain pattern assuming that individuals are captured initially soon after birth. An added disadvantage is that a very large number of animals usually must be captured to obtain an adequate sample of older aged animals. Method 3 also can give a true weight gain pattern; however, an accurate ageing technique which may require killing the animal must be utilized. The method described in this paper has some advantages over the above methods: individuals must be captured only twice and no ageing method, which may require sacrificing the animal, is necessary.

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METHODS

Between October, 1974, and March, 1977, nutria were captured on Blackwater National Wildlife Refuge and marked with ear-tags and web-tags. Body weights to the nearest 1/16 pound (28 g) were obtained at the time of capture.

Rates of change in body weight were estimated on the basis of fraction of initial body weight in units of $g \cdot g^{-1} \cdot day^{-1}$ as:

$$\frac{W_2 - W_1}{W_1(t_2 - t_1)} \tag{1}$$

where W_1 = weight at initial capture, g; W_2 = weight at second capture, g; t_1 = time of initial capture, days; t_2 = time of second capture, days.

One hundred seventy-one rates were calculated for 163 individual nutria—some having been captured three or more times. The period between captures varied from one to 810 days.

The fractional rates (G) calculated using eqn (1) are assumed to approximate a continuous rate which can be expressed as a time-dependent derivative of weight as an inverse function of body weight (W):

$$G = \frac{1}{W}\frac{dW}{dt} = b\left(\frac{W_{max}}{W} - 1\right) \tag{2}$$

where dW/dt = instantaneous rate of change in body weight, $g \cdot day^{-1}$; W_{max} = maximum body weight, g; b = a constant.

This relationship of fractional rate of change in body weight to body weight is found by plotting calculated values from eqn (1) against body weight (Fig. 1). The model (eqn 2) of fractional rate of change in body weight is fitted separately to the data on males and females using non-linear least squares regression on positive values only. The maximum weight (W_{max}) and its standard deviation predicted by least-squares regression for males was $6016 \cdot 67 \pm 0 \cdot 597$ g while that for females was $5246 \cdot 96 \pm 1 \cdot 245$ g. The values of the rate

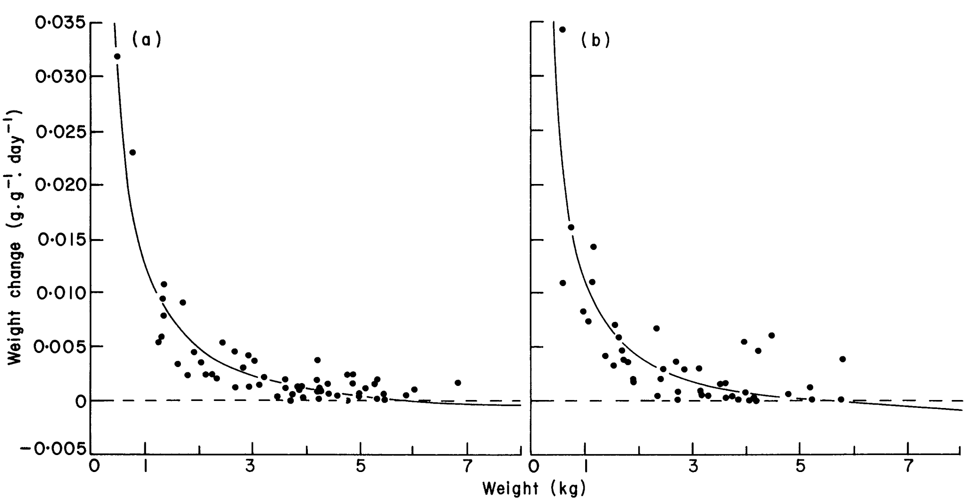

FIG. 1. Rate of change in body weight of feral male and female nutria from Maryland. (a) males; (b) females.

constant (b) also obtained from the least-squares regression are 0·00244 ± 0·000060 day^{-1} for males and 0·00247 ± 0·00012 day^{-1} for females (Dixon *et al.* 1979).

The predictive model of weight gain pattern is found by integrating eqn (2):

$$W = (W_{max} - W_0)(1 - e^{-bt}) + W_0 \tag{3}$$

where W_{max} and b are obtained from the least-squares regression and W_0 is the initial weight at birth.

Values from Newson (1966) and Atwood (1950) were used to calculate an initial weight of 227·36 g at birth. Predicted weight gain curves were calculated for males and females (Fig. 2) using positive rates only.

In addition to the 163 nutria used to determine G values, body weights were measured and ages determined using tooth development and wear (Aliev 1965) on 133 female and 233 male nutria. These data constitute independent data sets which can be used to validate the model of weight gain pattern (eqn 3).

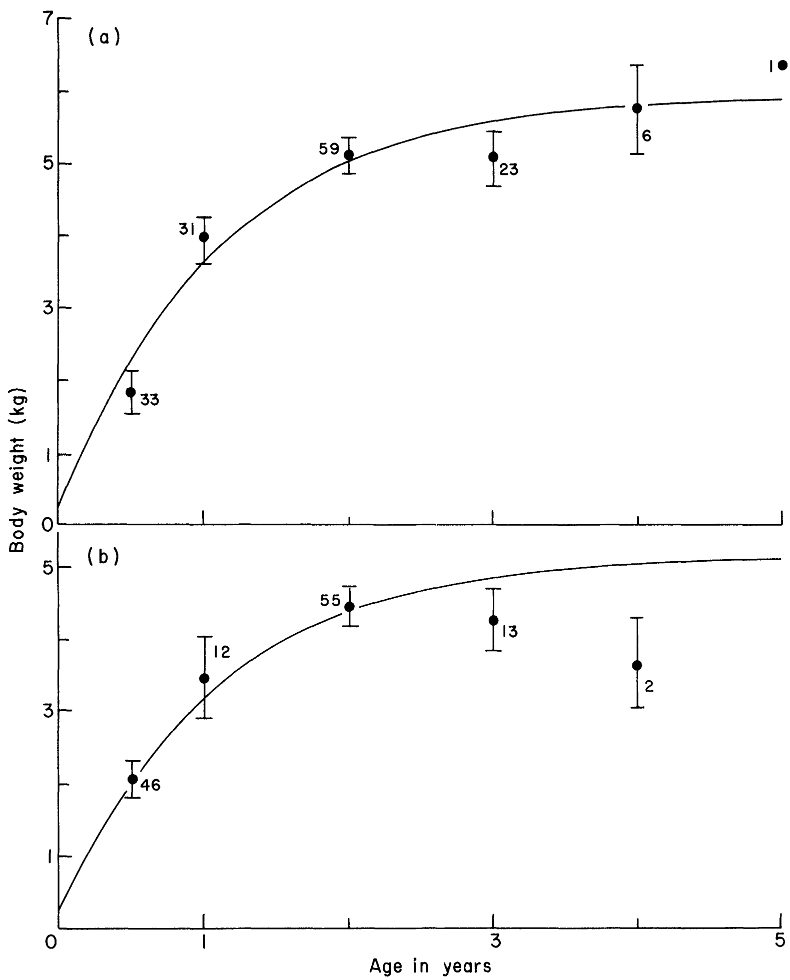

FIG. 2. Predicted and observed body weights by age of feral male and female nutria from Maryland. Error bars are 95% confidence intervals. Sample sizes are shown. (a) males; (b) females.

RESULTS AND DISCUSSION

Weights predicted by eqn (3) are compared with those weights measured for ages ranging from 6 months to 5 years (Fig. 2). In the case of male body weights, the model results compare favourably with observed weights at all ages. Regression of predicted weights against observed weights (Fig. 3(a)) weighted by sample size has a regression coefficient of 1·004 which is not significantly different from 1·0 ($P\{t(\nu) \leqslant t(1-\alpha); \nu\} = 0{\cdot}56$). For females (Fig. 2), the fit appears good for ages 6 months to 2 years with an increasing difference between predicted and observed weights with years 3 to 4. There is an apparent decline in female body weight with age although the regression coefficient of the weighted regression of predicted weights against observed weights (Fig. 3(b)) is 1·010. This value also is not significantly different from 1·0 ($P\{t(\nu) \leqslant t(1-\nu); \nu\} = 0{\cdot}67$). The decline in female body weight is supported by the condition of female nutria as measured by W/L^3 where W is body weight and L is body length. This index declined with age in female nutria but not in male nutria (Willner, Chapman & Pursley 1979).

The utility of this method of predicting age-specific body weight requires a valid model. If the apparent weight decline in female nutria is real, then a different model will be necessary. Because of the small sample size in age class four in both males (6) and females (2), the contribution of this age class to the regression is very small. Since the regression coefficients are not significantly different from 1·0, more data are required to test the validity of the model for females older than 2 years. Conversely, the model appears valid for males of all ages and for females through 2 years of age. The model should be useful for any species which maintains a fairly constant adult body weight.

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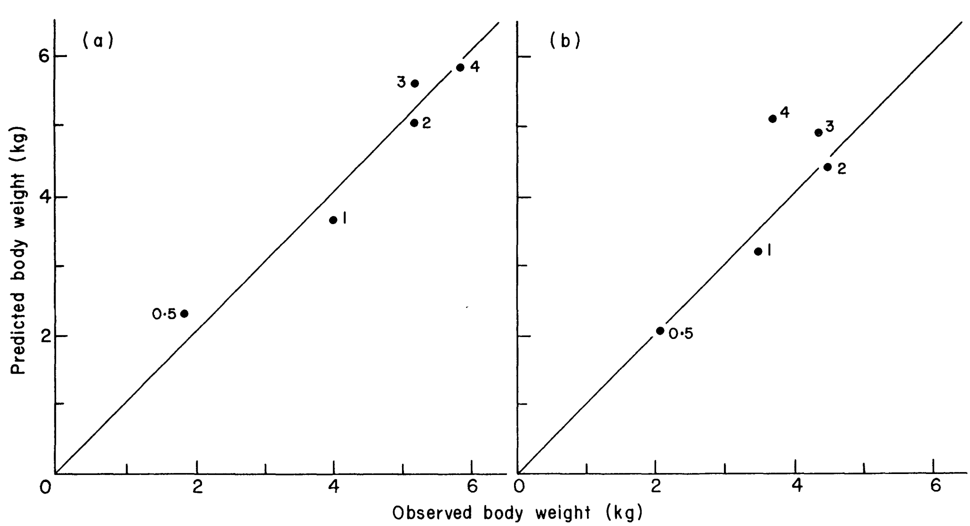

FIG. 3. Weighted regression of predicted body weights against observed body weights of feral male and female nutria from Maryland. Age class is given next to data points. (a) males; (b) females.

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