A TECHNIQUE FOR ESTIMATING BARN OWL PREY BIOMASS

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Abstract

A technique is described by which prey mandibles are used to estimate consumed prey biomass of Barn Owls. Such a technique can be used to estimate owl food consumption rates in the field.

Introduction

In this study a technique is described using the recovered mandibles of prey to estimate the biomass of prey individuals consumed by Barn Owls (*Tyto alba*). In previous Barn Owl studies, investigators used one of two methods for determining the consumed prey biomass. First, some investigators trapped small mammals in the owl's hunting area and determined mean weights (i.e., biomass) for these species. The biomass was then estimated by applying these weights to the species occurring in pellet samples (Evans and Emlen 1947, Fitch 1947, Otteni et al. 1972). Secondly, some authors converted prey weight into "prey units" (Southern 1954), using a 20 g mammal as the standard (Glue 1967, Webster 1973). When comparing different prey species of varying sizes, Southern (1954) believed an equalization of biomass ("prey units") is needed rather than comparing only total numbers of prey species. Both methods result in the determination of size differences among prey species but fail to consider the variation in size among individuals within a given prey species.

Materials and Methods

The Barn Owls investigated resided in an abandoned water tower 16 km NE of Fort Worth, Tarrant County, Texas.

Trapping results from a 1.3-hectare area adjacent to the nest site revealed four species of potential mammalian prey. Log-log regressions of right mandible length (mm) as a function of body wet weight (g) were determined from museum specimens of the known prey species and used to estimate the biomass of individuals in the pellets (table 1). Mandible length was measured from the anteriormost border of the concavity between the mandibular and angular processes and the dorsal border of the incisor socket (measured to the nearest 0.1 mm with a vernier caliper) (fig. 1). I chose this measurement because during the anlaysis of pellets (NaOH boiling method, see Schueler 1972), portions of mandibles are destroyed, but the portion shown in fig. 1 remained intact. Mandible measurements recovered from owl pellets were then applied to the regression equations to estimate the biomass of each individual represented in the pellets. Specimens used in the log-log regressions were obtained from local museums and were collected from 1973 to 1977 in north central Texas. Because of added body weight induced by reproductive conditions, gravid and lactating female specimens were excluded when determining regression equations.

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Table 1. Log-log regressions[1] from museum specimens.

Species	N	Range of Mandible Lengths (mm)	Log a	b	r	Level of Significance
Sigmodon hispidus Hispid cottonrat	73	12.4–18.4	-4.234	5.239	0.8957	$P<0.001$
Reithrodontomys fulvescens Fulvous harvest mouse	15	7.5–9.7	-1.769	2.958	0.7798	$P<0.001$
Baiomys taylori Pygmy mouse	17	7.2–8.6	-1.397	2.579	0.6173	$P< 0.01$
Peromyscus sp. White-footed mouse	13	8.3–11.5	-2.972	4.146	0.9519	$P<0.001$

[1] $\text{Log } Y = \text{Log } a + b(\text{Log } X)$

Results

Table 1 lists mammalian species potentially encountered by foraging Barn Owls, and the log-log regression equations of mandible length as a function of body wet weight for each species (all regressions were significant). Trapped specimens from the study area were not used to determine regressions because use of such individuals would present an added feeding pressure against the owls.

To demonstrate the biomass estimation technique, 73 museum specimens of *Sigmodon hispidus* (the dominant prey species recovered from pellets) were used to compute the following regression equation:

$$\text{Log } Y = -4.234 + 5.239(\text{Log } X)$$
$$(r = 0.8957, P<0.001)$$

where Log Y is the estimated prey biomass and Log X is the mandible length (see table 1). From pellet data, the mandible length variation of S. *hispidus* ranged from 10.0 mm to 17.8 mm, and was calculated to be from 10.1 g (apparent young) to 207.5 g (apparent adult) of prey biomass, respectively. Maximum and minimum mandible lengths and estimated biomass data for all prey species consumed by the owls are summarized in table 2.

Table 2. Variation in size of prey individuals recovered from Barn Owl pellets.

Prey Species	Mandible Length Max.	Mandible Length Min. (mm)	Estimated Biomass Max.	Estimated Biomass Min. (g)
Sigmodon hispidus	17.8	10.0	207.5	10.1
Reithrodontomys fulvescens	9.8	6.0	14.6	3.4
Baiomys taylori	9.7	6.5	14.1	5.0
Peromyscus sp.	10.3	8.5	16.8	7.6

Discussion

The Barn Owl is one of the species best suited for pellet analysis (Errington 1932, Glading et al. 1943, Raczyński and Ruprecht 1974). They swallow their prey whole without decapitation, insuring an accurate feeding record (Glading et al. 1943, Glue 1970, Marti 1974), and their prey can be identified by examination of skulls and mandibles. In a comparative study of Tawny Owl (*Strix aluco*), Long-eared Owl (*Asio otus*) and Barn Owl pellets, Raczyński and Ruprecht (1974) stated both avian and mammalian mandibles had the best recovery rate of the osseous remains in all three types of pellets. In fact, Barn Owl pellets had the lowest number of missing skeletal elements, and the lowest losses of prey individuals. Because of the relatively constant occurrence of mandibles in pellets, mandibles seem feasible as estimators of prey weight.

Otteni et al. (1972) used a mean weight value method of prey biomass estimation in their Barn Owl study. They reported that *Sigmodon hispidus* was the dominant prey of Barn Owls on the basis of biomass (20.8%) and used a mean weight of 170.0 g for each individual recovered from the pellets. In the present study, the technique described here indicated that Barn Owls consumed S. *hispidus* that ranged in estimated weight from 10.1 g to 207.5 g with a mean of 80.4 g/individual (S.D. $\pm$ 41.6, n = 478) (table 2). Since the breeding seasons of the small mammals in Texas are nearly continuous throughout the year (Davis 1974), it is possible for owls to capture young, juvenile, and/or adult prey in almost any month of the year. Application of mean weights of prey to the number of recovered individuals per species as a means of estimating biomass may not be as reliable as needed for prolonged studies of food habits.

Many British investigators use the "prey unit" method (Southern 1954) to compare the importance of prey species in owl diets (Glue 1967, Webster 1973). Glue (1967) stressed that this method served as an indicator of the relative importance of each prey species in the owl's diet rather than reflecting its absolute nutritional importance.

The significance of the biomass estimation technique discussed here is that it will allow the investigator to accurately measure owl food consumption rates in the field. This precise method is applicable to any field bioenergetic or food optimization study.

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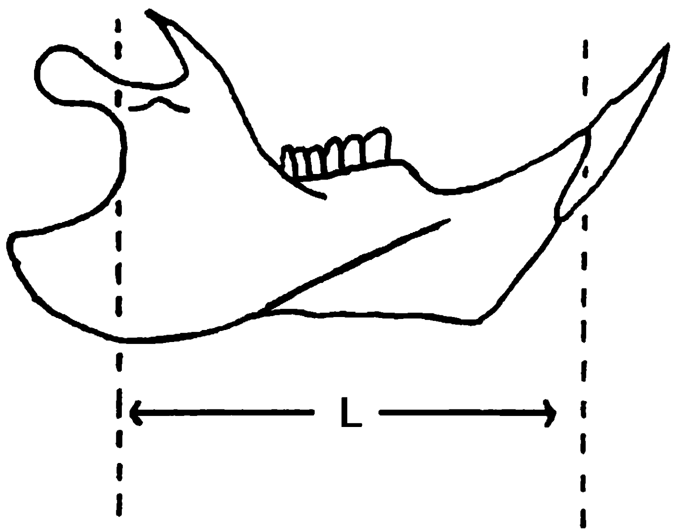

Figure 1. Mandible length (L) measurement used for estimates of individual prey biomass from museum specimens and recovered pellet materials.