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PREY SELECTION AND BIOENERGETICS OF CAPTIVE SCREECH OWLS[1]

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ABSTRACT. Screech owls appeared to select meadow voles (*Microtus pennsylvanicus*) as a primary food source, although deer mice (*Peromyscus maniculatus*) were apparently equally abundant and vulnerable. This feeding behavior resulted in a larger energy reward. A mean ingestion rate of 0.37 kcal/g live wt/day was derived from average values of 29.3 g live wt/day for *Microtus* as prey and only 11.3 g live wt/day for *Peromyscus*. Assimilation energy (ingestion-pellets-feces) was 0.28 kcal/g live wt/day; the mean assimilation efficiency (ingested energy-pellet energy-fecal energy/ingested energy x 100) was 76%. These findings support the hypothesis that a large energy reward is a prime factor in prey selection.

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INTRODUCTION

The Screech Owl (*Otus asio*) has been shown to select transient over resident white-footed mice (*Peromyscus leucopus*) (Metzgar 1967), white over agouti house mice (*Mus musculus*) (Kaufman 1974a), active over inactive house mice (Kaufman 1974b), conspicuous over nonconspicuous old-field mice (Kaufman 1974c), and smaller over larger white laboratory mice (Marti and Hogue 1979). An objective of the present investigation was to determine if Screech Owls would select a larger and more diurnal prey species, namely the meadow vole (*Microtus pennsylvanicus*), over a smaller and more nocturnal prey species, namely the deer mouse (*Peromyscus maniculatus*). Both species constitute the Screech Owl's normal diet (Errington 1932, Wilson 1938, Craighead and Craighead 1969). Another objective of the present investigation was to measure Screech Owl bioenergetics under semi-natural field conditions.

METHODS AND MATERIALS

This study was conducted at the Miami University Ecology Research Center on the Bachelor Wildlife Reserve in close proximity to Oxford, Ohio. An aviary (9.1 x 6.1 x 3.7 m), described in detail by Barrett and Mackey (1975), was divided into two identical enclosures, each having a volume of 100.8 m^3. The west wall of both enclosures was covered with burlap to provide shade and visually to separate the owls. Tree branches were attached to the middle of each west wall to furnish a more natural roosting site. Shelter boxes, each 0.6 x 0.5 x 0.9 m, were placed within these branches 2.5 m above ground level. Perches were located in all four corners of each enclosure at a height of 2.7 m. A perch spanned the middle of each aviary, running east and west, at a height of 2.5 m.

Vegetation approximately 0.5 m high in each enclosure consisted primarily of giant fox tail (*Setaria faberii*). A swath of vegetation approximately 0.8 m wide was mowed around the perimeter of each enclosure. Additional cover (straw) was added to the 4.5 x 3.0 m unmowed *Setaria* section in the center of each aviary. The purpose of this design was to provide a central covered area and an outside open area of equal proportion (13.5 m^2). It has been shown that *Microtus* prefer an area with good vegetative cover (Eadie 1953), whereas *Peromyscus* prefer an area of sparse vegetative cover (Hayne 1936). In addition to the *Setaria faberii*, 300 g of lettuce were distributed daily in the center area for the *Microtus*, while the diet of the *Peromyscus* was supplemented with wild bird seed scattered along the perimeter at a rate of 150 g per day. Food resources were located, therefore, in the optimum habitat for each prey species.

An adult Screech Owl was introduced into each enclosure on 16 September 1977 for a 4-day acclimation period. *Microtus* and *Peromyscus* were released in each aviary for the owls to prey on during the acclimation period. Both owls and any remaining mice were removed to the laboratory following the period of acclimation.

Ten adult *Microtus* and ten adult *Peromyscus* (5 male

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and 5 female each) were then introduced into each enclousure for a 3-day prey acclimation period. Each small mammal was weighed and marked before being released. Mean body weights were 36.0 g for *Microtus* and 16.3 g for *Peromyscus*. Animals were marked by attached lettered metal bands around the hind leg (Southern and Lowe 1968) and by toe-clipping.

Screech Owls were weighed before being released into the enclosures. Initial weights of 160.9 and 148.0 g ($\bar{X}$ = 154.5 g) were similar to the mean value of 153.7 g reported by Craighead and Craighead (1969). Regurgitated pellets were collected daily at noon, oven-dried at 80 °C for 72 hr, weighed, and examined for tags and skull fragments to determine prey species consumed (Driver 1949, Kaufman 1973).

Caloric conversion equivalents of 4.65 kcal/g dry wt for *Microtus* (Golley 1960) and 5.20 kcal/g dry wt for *Peromyscus* (Kaufman *et al* 1975) were used to calculate the owls' ingestion rates. The rate of egestion (feces) was calculated using Graber's (1962) estimate of 8% of the average food intake. Secondary production (growth) was determined using Brisbin's (1968) caloric equivalent of 2.61 kcal/g live wt for adult Mourning Doves (*Zenaidura macroura*).

RESULTS AND DISCUSSION

Daily observations revealed that *Microtus* were active strictly in the high vegetation habitat, whereas *Peromyscus* were located in the open habitat with numerous burrows visible along the enclosure walls. *Peromyscus* have been documented as being a noctural species (Falls 1968), while some discrepancy exists concerning *Microtus* activity patterns. Hamilton (1937) reported that *Microtus* are generally more active by day, with heightened activity patterns occurring shortly after dawn and in the hours preceding dusk. Ambrose (1973) agrees with the general tendency of *Microtus* to be more diurnal than nocturnal, but his data also show that at least 50% of the population were active at any given hour of day or night. We observed that *Microtus* was very active during the day with both prey species being active shortly after dusk when the owls first appeared out of their roosts.

Statistical analysis of the prey capture data (fig. 1) resulted in a linear function (r^2=0.89; P<0.01) for *Microtus* in contrast to a cubic function (r^2=0.93; P<0.01) for *Peromyscus*. Therefore, voles were selected in a continuous manner during the total study period. Owls selected (8-4) the more abun-

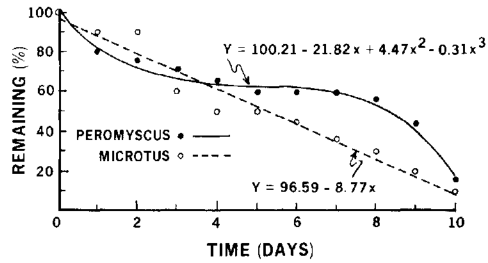

FIGURE 1. Graph demonstrating small mammal prey selection patterns for captive Screech Owls maintained under semi-natural conditions.

dant *Peromyscus* during the final days of the study when the *Microtus* population had been reduced by over 75%. The study was terminated when the owls began to lose weight and no additional pellets could be located. Two *Peromyscus* in enclosure I and one *Peromyscus* and two *Microtus* in enclosure II were trapped out upon termination of the study on day 11.

Figure 2 summarizes Screech Owl mean daily energy flow values. A mean ingestion rate of 0.37 kcal/g live wt/day was derived from average values of 29.3 g live wt/day for *Microtus* and 11.3 g live wt/day for *Peromyscus*. Each bird consumed 26% of its body wt/day. Pellet energy lost was 0.06 kcal/g live wt/day and loss due to urine and fecal matter was estimated to be 0.03 kcal/g live wt/day. Production was nonsignifi-

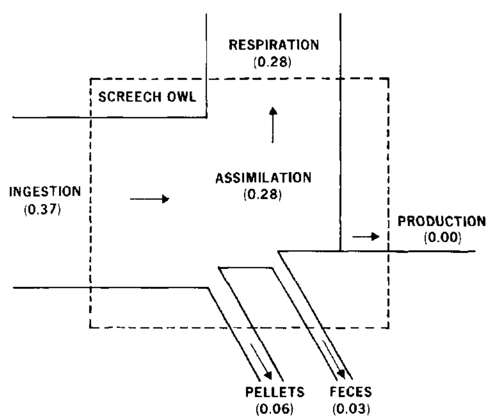

FIGURE 2. Energy flow diagram for adult Screech Owls maintained under semi-natural aviary conditions. All values expressed as mean kcal/g live wt/day.

cant, with only a 0.07 g live wt/day being added in weight gain. Assimilation energy (ingestion-pellets-feces) was 0.28 kcal/g live wt/day with a mean assimilation efficiency (ingested energy-pellets-feces/ingested energy x 100) of 76%. Respiration (assimilation-production) was 0.28 kcal/g live wt/day. Wallick and Barrett (1976) found a similar assimilation efficiency (77%) for Barn Owls (*Tyto alba*), a bird of much greater size and weight ($\bar{X}$=515 g).

It should be noted that the energy flow values were based on outdoor aviary conditions during the month of October (mean temperature 7.5 °C). Differences in energetic values may be attributed to variation in seasonal and experimental conditions. Marti (1973) reported the ingestion rate for the Burrowing Owl (*Speotyto cunicularia*), a bird of comparable size ($\bar{X}$= 169.8 g) to the Screech Owl, to be 33.7 g wet wt/day. His study was conducted in an aviary (1.0 x 1.6 x 1.6 m) from 14 October through 11 November. Studies of the Saw-whet Owl (*Aegolius acadicus*) ($\bar{X}$=95 g) found food intake under aviary conditions to vary from 0.63 kcal/g/day (Graber 1962) to 1.10 kcal/g/day (Collins 1963). Craighead and Craighead (1969) reported the fall and winter food requirements of the Screech Owl to average 39.0 g wet wt/day, a value almost identical to our value of 40.5 g wet wt/day.

Numerous theories have been proposed in attempting to explain the complex relationship between predator and prey. These include prey availability (McAtee 1932), conspicuousness with regard to coloration (Dice 1947, Kaufman 1974a, 1974c), innate behavioral responses (MacArthur 1958, MacLellan 1959), prey activity (Metzgar 1967, Ambrose 1972), prey vulnerability (Craighead and Craighead 1969), and oddity and specific search image (Mueller 1971). Regarding our investigation, abundance may be discounted as both *Microtus* and *Peromyscus* were of equal numbers. An attempt was made to minimize the effect of a specific search image by feeding the owls both prey species prior to the study. Prey activity and vulnerability, however, are factors which must be considered.

It has been demonstrated that owls locate their prey both visually (Dice 1945) and auditorily (Bent 1937). *Peromyscus* were probably more visible as they moved about the mowed habitat in contrast to *Microtus* which moved along established run-ways under heavier vegetative cover. Kaufman (1974a) has reported, however, that the Screech Owl was equally effective in capturing prey (*Mus musculus*) in both sparse and dense vegetation. Marti and Hogue (1979) have also reported that Screech Owls select smaller instead of larger prey (*Mus musculus*) under laboratory conditions. Prey vulnerability, therefore, should have favored the nocturnal *Peromyscus* as the preferred food source over the diurnal or crepuscular *Microtus*. Such was not the case in the present investigation.

In summary, the Screech Owl appeared to select *Microtus* as the primary food source, although *Peromyscus* were considered to be equally abundant and vulnerable. This feeding behavior resulted in a larger energy reward. Interestingly, Barrett and Mackey (1975), in an identical experimental design utilizing the American Kestrel (*Falco sparverius*), also found *Microtus* to be selected as the primary food source during the initial part of their study. This feeding strategy is surprising due to differences between these two raptors' activity patterns, *i.e.*, the American Kestrel is diurnal in contrast to the Screech Owl, which is nocturnal. These findings support the hypothesis (Barrett and Mackey 1975) that a large energy reward is a prime factor in prey selection over, perhaps, prey availability or vulnerability.

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