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Author(s): J. Hoyt Slade, William B. Arnold and Michael V. Plummer

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Efficiencies of Digestion and Assimilation in the Gecko *Hemidactylus turcicus*

J. HOYT SLADE, WILLIAM B. ARNOLD, AND MICHAEL V. PLUMMER, *Department of Biology, Harding University, Searcy, Arkansas 72143, USA.*

The gekkonid lizard *Hemidactylus turcicus* is a widespread and highly successful exotic in the United States, often occurring at high densities (e.g., Rose and Barbour, 1968). Various aspects of the ecology of these populations have been studied (King, 1958; Rose and Barbour, 1968; Trauth, 1985; Selcer, 1986, 1987; Paulissen and Buchanan, 1991), but little information relative to energetics (Selcer, 1987) is available. Here we report on efficiencies of digestion and assimilation in *H. turcicus* and compare them to those reported for various insectivorous non-gekkonid lizards.

Adult *H. turcicus* were captured 15 September 1992

in Baton Rouge, Louisiana. Geckos ranged from 45-54 cm snout-vent length (SVL) and 2.2-3.9 g body mass. Geckos were housed individually in glass jars (25 cm height × 15 cm diameter) containing wooden shelter boxes (9 × 5 × 18 cm). Water was provided ad libitum. Jars containing geckos were maintained in an environmental chamber at 27 C on a 12L:12D photoperiod. After measuring SVL and mass, geckos were starved for 3 wk and then checked for gut clearance by palpation. Each gecko was then fed one pre-weighed 3-6 wk old cricket (*Acheta domestica*) every 3 d for 70 d. All geckos fed regularly and maintained or gained body mass during the experiment (mean mass gain = 10.6%, SD = 7.2). Crickets were fed poultry pellets dusted with vitamins. Water content of crickets was determined by drying samples of at least 10 crickets each for 24 h at 60 C and subtracting the resulting mass from wet mass. Feces and solid urinary wastes of geckos were collected and pooled for each individual gecko after each feeding. Urinary wastes were manually separated from feces, and each was frozen separately until processed. Processing involved drying at 60 C for 24 h, grinding into homogenous mixtures, pressing into pellets, weighing, and then bombing the pellets in a PARR Semimicro Oxygen Bomb Calorimeter (PARR Instrument Co., Moline, Illinois). Crickets were processed likewise to determine caloric content. Dry masses of crickets, feces, and urinary wastes were corrected for ash content determined by weighing the residue remaining after bombing each sample (Smith, 1976).

Efficiencies of digestion and assimilation were calculated using the equations of Kitchell and Windell (1972) as modified by Johnson and Lillywhite (1979). Digestive efficiency (DE) is the percent of calories absorbed through the gut and is calculated as $(C - F)/C \times 100$, where C = calories consumed and F = calories of fecal waste. Assimilation efficiency (AE) is the percent of useable calories retained by the animal and is calculated as $(C - (F + U))/C \times 100$, where C = calories consumed, F = calories of fecal waste, and U = calories of urinary waste.

For crickets, mean water content was 76.7% (SD = 0.91, N = 5), mean ash content was 4.2% (SD = 1.04, N = 3), and mean caloric content was 5298 cal/g (SD = 103.6, N = 3). For 13 geckos, mean mass of crickets consumed was 1.07 g (SD = 0.070), mean mass of feces was 0.22 g (SD = 0.043), mean caloric content of feces was 3377 cal/g (SD = 203.9), mean mass of urinary wastes was 0.34 g (SD = 0.027), and mean caloric content of urinary wastes was 2470 cal/g (SD = 26.1). Mean digestive efficiency was 87.0% (SD = 2.27, range = 83.2-90.3, N = 13) and mean assimilation efficiency was 72.4% (SD = 2.13, range = 69.0-74.8, N = 13).

Efficiencies of digestion and assimilation in *H. turcicus* are similar to those reported for various other insectivorous and omnivorous lizards fed insects, including anguids, iguanids, lacertids, teiids, and xantusids (DE = 80-90%; AE = 70-80%; Waldschmidt et al., 1987). Such efficiencies in lizards may vary according to kind of food and body temperature (Harwood, 1979; Waldschmidt et al., 1987). Because our geckos could not choose either their food or body temperature as do free-living *Hemidactylus* spp. (Marcellini, 1976; Avery, 1981), the significance of our laboratory results relative to the biology of *H. turcicus* under natural field conditions is unknown.

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Do Flag Markers Attract Turtle Nest Predators?

TRACEY D. TUBERVILLE AND VINCENT J. BURKE, *Savannah River Ecology Laboratory, University of Georgia, Drawer E, Aiken, South Carolina 29802, USA.*

Studies that monitor the fate of turtle nests often require a system that allows identification of individual nests. In many studies of turtle nests, plastic flagging is used for this purpose (J. Congdon, pers. comm.; Fowler, 1979). Because of their conspicuous nature, flags may affect visitation rates to nest sites by predators. Previous studies on potential effects of flags have focused primarily on predators of ground-nesting birds (Baker, 1978; Yahner and Wright, 1985). These studies suggested that avian predators, such as crows, do associate some types of nest markers with nest sites. However, no evidence was found that suggested mammalian predators were attracted to nest markers (Baker, 1978, 1980). Some researchers have avoided use of nest markers due to concern that markers might attract predators to bird nesting sites (Angelstam, 1986; Yahner and Cypher, 1987). However, we know of no studies that have investigated the effect of flagging on predators of turtle nests.

We examined the potential attractive and repulsive effects of plastic flagging material on turtle nest predators at Ellenton Bay, a 10 ha Carolina bay (marsh-type habitat) on the Savannah River Site in west-central South Carolina. Turtle species nesting at Ellenton Bay include *Kinosternon subrubrum*, *Sternotherus odoratus*, *Pseudemys floridana*, *Trachemys scripta*, *Chelydra serpentina*, and *Deirochelys reticularia* (Gibbons, 1970). Potential mammalian nest predators known to occur at Ellenton Bay include striped skunks (*Mephitis mephitis*), gray foxes (*Urocyon cinereoargenteus*), and raccoons (*Procyon lotor*). Qualitative observations (e.g., scat and tracks at depredated nests) indicate that raccoons are the predominant above-ground nest predators.

Turtle nests at Ellenton Bay were located by following transmitter-equipped turtles to nest sites. During the 1993 nesting season (April-July), one *S. odoratus*, four *C. serpentina*, eight *T. scripta*, 16 *P. floridana*, and 53 *K. subrubrum* nests were marked with two wire stake flags placed ≈ 50 cm from the nest on opposite sides. Nests were checked weekly for evidence of predation. Sixty-seven of the 82 monitored nests were destroyed during the study. Terrestrial predation was verified for 40 of the 67 destroyed nests. Flags were constructed of 6.35 cm \times 9.0 cm fluorescent pink plastic mounted on 90 cm wire stakes (Forestry Suppliers, Inc., Jackson, MS, Pink Glo #33516). We considered the potential effects of flagging on nest predators to include: (1) no effect, (2) reduced visitation due to repulsion, (3) increased visitation due to attraction, and (4) increased visitation due to association of flagging with turtle nests, in that predators have previously located flagged nests containing eggs.

Three methods were employed to test for possible effects of flagging on mammalian predators. All methods were tested in areas where natural turtle nests were marked with two wire stake flags.