Effects of Food Availability on Energy Allocation in *Sceloporus undulatus*

Haley Oakley, Lydia Dudley, Joshua Hall

Introduction

Organisms have a limited amount of energy available for growth, maintenance, and reproduction (Smith and Fretwell 1974). The total amount of energy available changes seasonally and between years as environmental conditions fluctuate (Ferguson et al. 1982). *Sceloporus undulatus*, the Eastern Fence Lizard, is an important model for life-history evolution, so we sought to identify how variation in food availability affects the energy allocation of these lizards

Methods

We collected 24 male:female pairs (**Fig. 1**) from two populations: Edgar Evins State Park, Silver Point, TN and Standing Stone State Park, Hilham, TN (~ 56 km apart).

We measured each individual's body mass (g), snout-vent length (SVL) (mm), and tail length (mm).

Male:female pairs from the same locations were housed in 42 x 42 x 76 cm mesh cages with fake vines, a block for sunning/cover, and a nest pot for laying eggs in the TN Tech Aviary.

The lizards were fed a standard diet of vitamin-dusted crickets (n = 5 crickets each, 3 times per week) until they laid a clutch, after which they were randomly assigned to a low quality diet (n = 3 crickets per lizard, 3 times per week) or a high quality diet (n = 10 crickets per lizard, 3 times per week). We measured the mass of crickets given each feeding.

Cages were checked daily for eggs

Clutch sizes and individual egg mass (g), length (mm), and width (mm) were recorded

After the breeding season, adults were measured, euthanized, and dissected to measure their liver (g), fat pads (g), and ovaries/testes (g)

Current analyses focus on female *S. undulatus*.

Literature

Ferguson, G. W., Brown, K. L., & DeMarco, V. G. (1982). Selective basis for the evolution of variable egg and hatchling size in some Iguanid lizards. *Herpetologica, 38*(1), 178–188.

Parker, W. S., & Pianka, E. R. (1975). Comparative ecology of populations of the lizard *Uta stansburiana*. Copeia, 1975(4), 615–632.

Smith, C. C., & Fretwell, S. D. (1974). The optimal balance between size and number of offspring. *The American Naturalist, 108*(962), 499–506.

Turner, F.B; Medica, P.A; Smith, D.D. 1973. International Biological Program, Desert Program, Logan, UT. Reproduction and survivorship of the lizard, *Uta stansburiana*, and the effects of winter rainfall, density and predation on these processes. RM 73-26.

Table 1. Hypothesized observations given investment in maintenance, growth, or reproduction.

Investing in:	Expected responses:
Maintenance only	No SVL growth or reproduction.
Growth only	Increase in SVL, no reproduction
Reproduction only	Lays a clutch of eggs, no SVL growth
Reproduction & Growth	SVL increases, 1+ clutch(es) laid.

Results

Larger females (> 60 mm SVL) had a higher probability of reproducing. (**Fig. 2**)

Egg mass was affected by the mom's SVL, the number of eggs in the clutch, and the interaction between the two. Cricket mass had a significant effect on clutch size but not egg mass. Small females (those under the reproductive size at capture: SVL ~ 60 mm) and large females (SVL > 60 mm upon capture) had different relationships between their eggs' wet masses and their clutch size. Large females could increase both egg mass and clutch size; for every additional egg in the clutch, the individual egg wet mass increased by 14.81 mg (± 2.31 SE), while small females had a negative relationship between the two; for every additional egg in the clutch the individual egg wet mass decreased by 43.28 mg (± 4.27 SE), giving larger females a higher reproductive potential. (**Fig. 3**)

The trends in reproduction, growth, and body condition were as expected, though not statistically significant. High quality diet females had the greatest reproduction (**Fig. 4**), greater growth than poor-quality diet females (**Fig. 5**), and the greatest final body condition (**Fig. 6**). The low quality diet females stopped investing in reproduction, with none laying another clutch after being placed on the low diet (**Fig 4**). Non-reproductive females allocated their energy towards having the greatest growth (**Fig. 5**) in order to reach reproductive size.

Final mass of fat pads between the females in the high and low quality diets were significantly different (P = 0.008; SE ± 0.80 (**Fig. 5**)

We found no affect of food availability on final liver mass, follicle mass, or change in body condition.

Conclusion and Future Directions

Individuals under reproductive size at the start of the breeding season have less reproductive potential and invest primarily in growth.

In low-quality environments, individuals will forgo reproduction and growth to try to survive to the next breeding season, where conditions may be better.

We'll also be doing these analyses on the males

Figure 1. Male (top) and female (bottom) *S. undulatus* pair in their enclosure

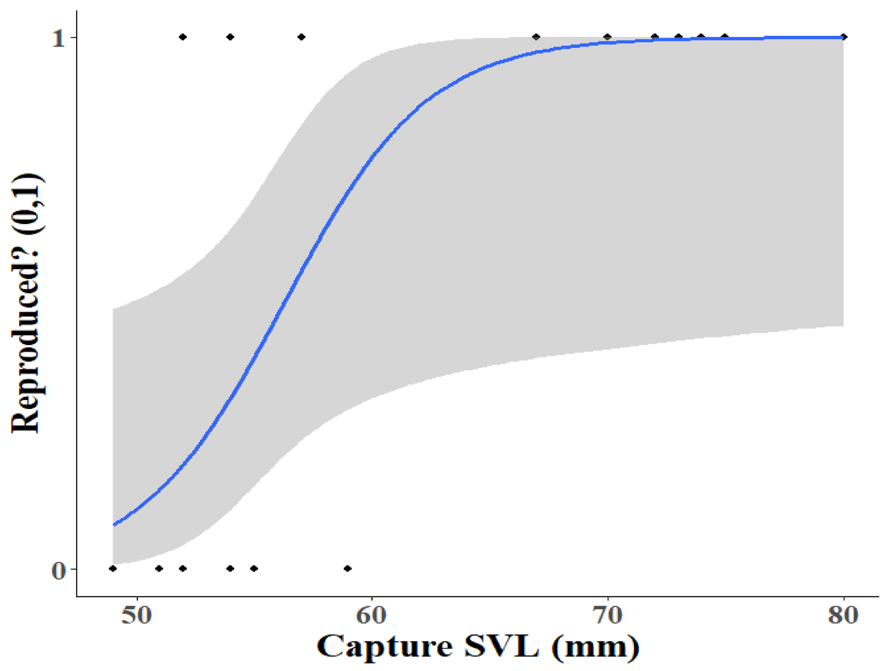

Figure 2. Probability curve of reproduction based on SVL (mm) at capture. The blue line represents the probability curve of if a female reproduces or not based on her SVL (mm) when she was captured at the beginning of the breeding season. The black dots represent the raw data of capture SVLs. The shaded area represents the 95% confidence interval.

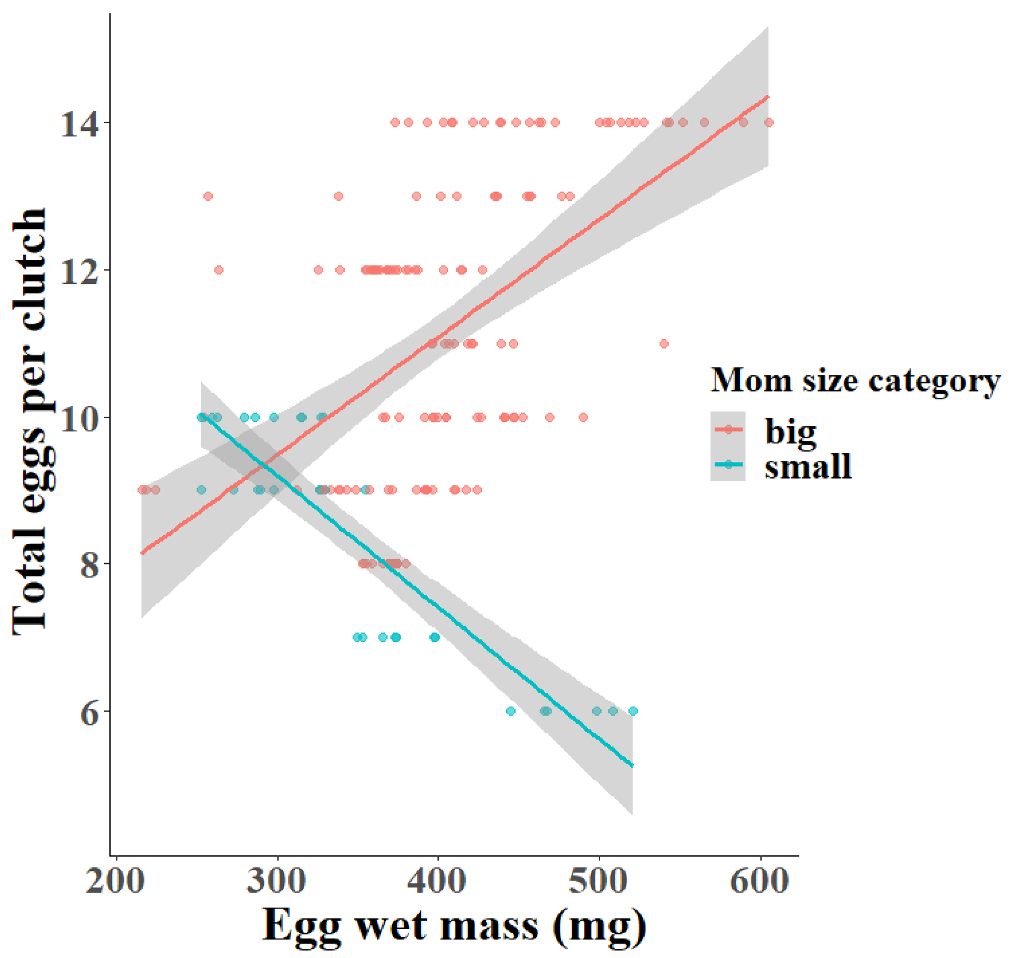

Figure 3. Number of eggs in first clutch versus wet mass (mg) of the individual eggs separated by size category of the mom. Red line represents the trend between clutch size and egg size for bigger females (> 60 mm SVL upon capture). Blue line represents the trend between clutch size and egg size for smaller females (≤ 60 mm SVL upon capture). Shaded areas represent a 95% confidence interval. Closed circles represent raw data points.

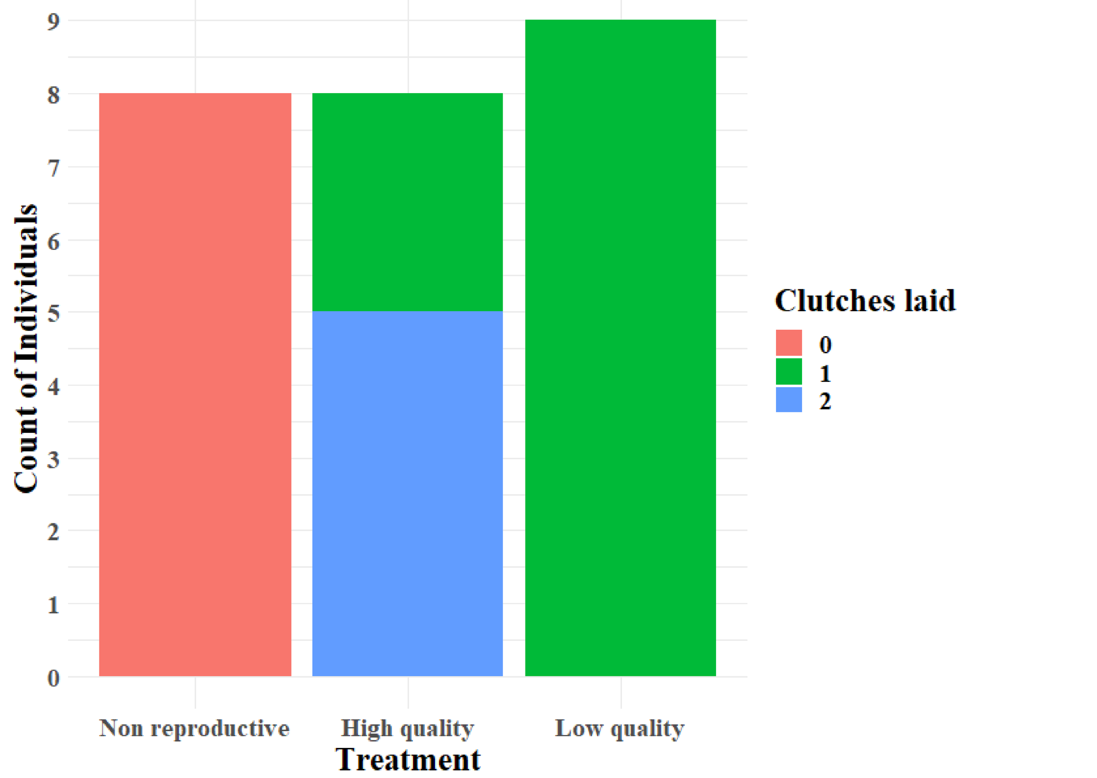

Figure 4. Number of clutches laid per female by treatment.

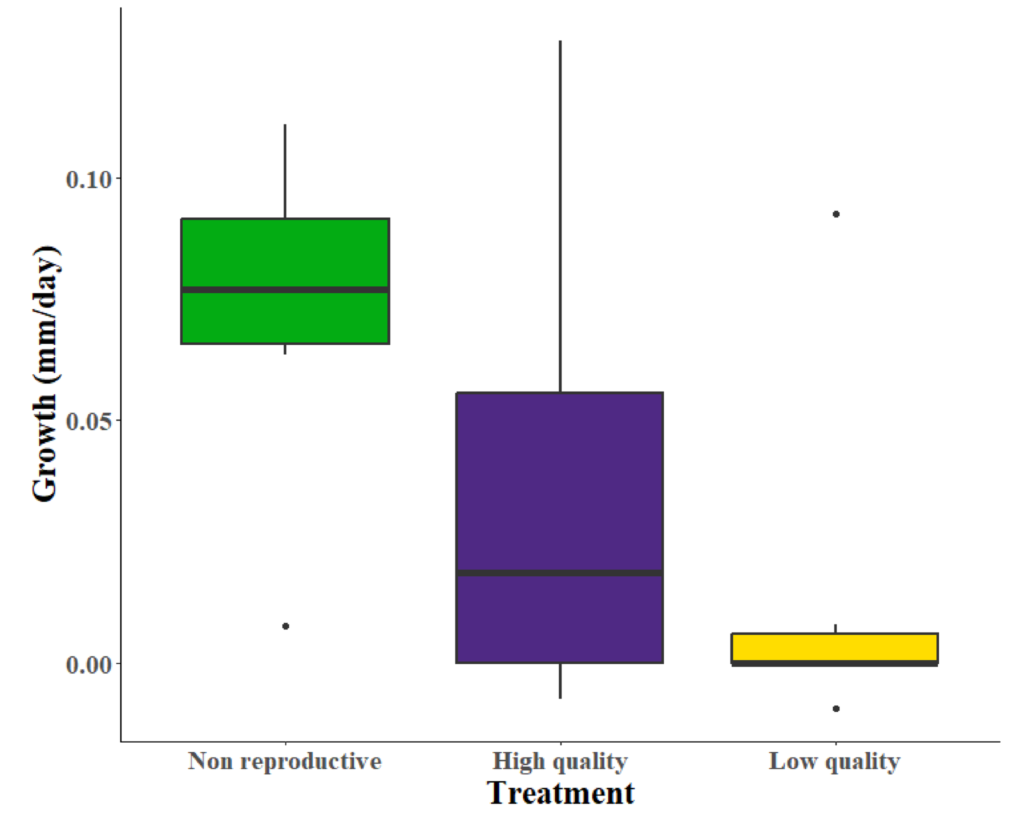

Figure 5. SVL growth rate (mm/day) by treatment.

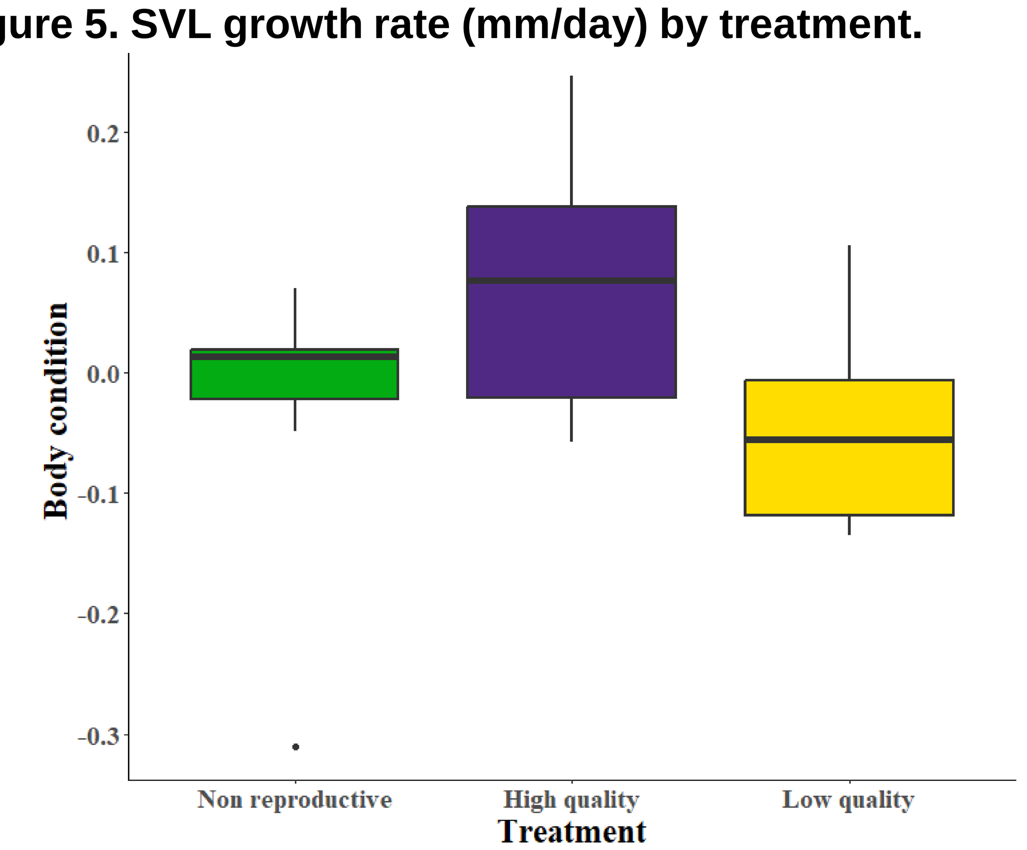

Figure 6. Final body condition by treatment. Body condition = residuals(lm(log(FinalBodyMass) ~ log(FinalSVL))

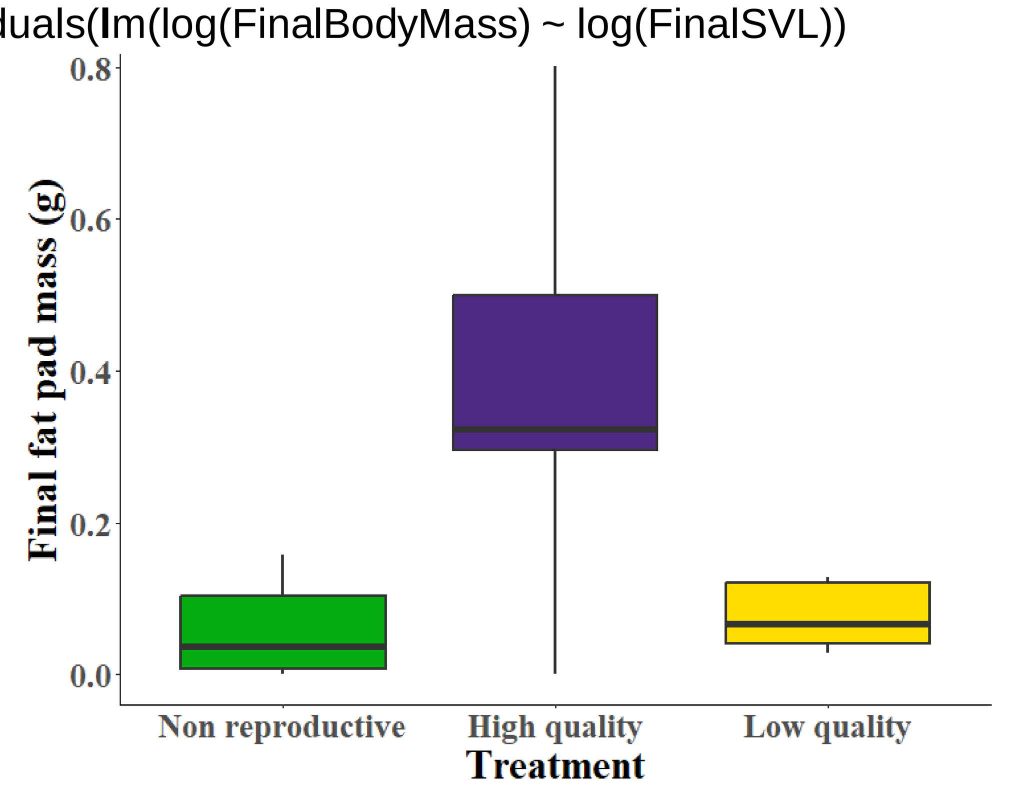

Figure 7. Final mass of fat pads from female *Sceloporus undulatus* by treatment. Difference in measured mass (g) of the fat pads removed from the reproductive females upon dissection at the end of the study.

Acknowledgements: Thank you to Tennessee Technological University for funding and use of facilities and to the American Philosophical Society for funding.